JPRS-TND-86-004

7 February 1986

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS-TND-86-004

7 February 1986

WORLDWIDE REPORT

NUCLEAR DEVELOPMENT AND PROLIFERATION

CONTENTS

ASIA

INDIA

PAKISTAN

AUSTRALIA

FRG URANIUM MINER ABANDONS LOCAL EXPLORATION

Sydney THE AUSTRALIAN 26 Dec 86 p 11

[Article by Ian Howarth]

[Text]

URANGESELLSCHAFT Australia Pty Ltd (UG), the local arm of the uranium exploration company established by the West German Government, will quit exploration in Australia.

The decision follows action by the Federal Government in February when it accused UG of trying to subvert Australia's uranium export policies.

The Government accused UG of selling a 100-tonne shipment of uranium to a French trading company to extricate itself from a contract with the operators of the Ranger uranium mine in the Northern Territory.

The company strongly denied the accusation.

This week, UG's sole remaining Australian representative, Mr John Barr, said the decision to quit Australia was a direct result of commercial and political factors.

UG is the holder of a 4 per cent equity in the Ranger mine, operated by Energy Resources of Australia Ltd (ERA); a 10 per cent stake in the Yeelirrie uranium project in Western Australia and a 40 per cent stake in the Westmoreland uranium deposit in Queensland.

Mr Barr said the decision to quit Australia was disappointing.

He described the Federal Government's action as "commercially unprecedented".

Mr Barr said UG was engaged in negotiations to sell most of its Australian interests, which included substantial equity interests in a wide range of exploration leases.

The company was at one time Australia's major uranium exploration group.

It once employed 24 field geologists, but in the past 12 months its exploration efforts have been considerably scaled down in the face of a declining world market for uranium, and intense political opposition.

Reputation

UG will retain its Ranger, Yeelirrie and Westmoreland interests.

Mr Barr said the company had reduced its international uranium exploration efforts in the past year in the face of the shrinking world demand.

It is particularly active in the United States, Canada and South America.

Mr Barr was reluctant to comment on whether Australia's reputation as an international trading partner had been substantially harmed by the Federal Government's actions.

The company said in an advertisement in *The Australian* announcing its decision: "UG Australia Pty Ltd will cease exploration in Australia and

close its office at 608 St Kilda Rd, Melbourne on December 20, 1985."

It was signed by Dr W.E. Schindlmayr, managing director, technical.

The political drama which prompted UG to leave Australia was sparked by the Federal Minister for Trade, Mr Dawkins.

Mr Dawkins issued a statement which said he believed UG had contrived a situation which it hoped would permit it to break a contract with ERA.

The contract specified UG would accept 400 short tonnes of uranium yellowcake a year from the Ranger mine.

Mr Dawkins accused UG of trying to sell 100 tonnes of yellowcake to a French trading company in a bid to have the sale stopped by the Australian Government.

He said this stoppage would then allow UG to withdraw entirely from its contract.

However, UG denied the charge strenuously and said that even if the Government stopped the sale, it would not be able to cancel the contract.

The matter went as high as embassy level in Australia and West Germany and caused a diplomatic furore.

Mr Dawkins accused UG of trying to pull out of its contract on commercial grounds. He said the Australian floor price for uranium, which is the minimum price paid by UG for ERA yellowcake, was higher than the prevailing international spot price at the time.

Ultimately, Mr Dawkins declined to ban the sale of the disputed 100-tonne shipment of yellowcake. He said he was convinced the U308 was not destined for use in France despite it being sold to the French trading company, Enership SA.

/12828
CSO: 5100/4304

AUSTRALIA

NUCLEAR EXPERT CRITICIZES GOVERNMENT URANIUM RESTRICTIONS

Sydney THE AUSTRALIAN 31 Dec 85 p 10

[Text] FEDERAL Government restrictions on the development and export of uranium deposits are locking Australia out of a growing world market, according to an expert on nuclear energy.

Dr Leslie Kemeny says that unless something is done soon, Australia may miss the uranium boat. He says international demand for uranium is accelerating, offering Australian producers enormous challenges and opportunities.

Yet, despite having the world's largest known reserves, and low-cost producers, Australia is giving away the major advantage it holds.

Dr Kemeny, a senior lecturer in nuclear engineering at the University of New South Wales, made his comments in an article published in the latest issue of the Mining Review of the Australian Mining Industry Council.

He says that at the beginning of next year, Australia stands at the cross-roads for full-scale development of its uranium mining industry.

He gives three main reasons for this increase in demand.

About 60 nuclear power stations in the United States will be completed and awaiting licensing in the next two to three years; many developed countries are increasing their nuclear generating capacities by about 15-20 per cent a year; many Third World countries are increasing their capacities.

"No nation sitting on top of what could now prove to be 30 to 40 per cent of the world's prime fuel resources has the moral right to either withhold supply or to renege on existing contracts," Dr Kemeny says.

Australia has only two producing uranium mines: Ranger and Nabarlek in the Northern Territory, with the Roxby Downs mine having recently been given the go-ahead.

Dr Kemeny says Canada is set to increase its share of the world market from 22 per cent to 31 per cent in the next five years.

"There is no doubt that Australia could supply larger quantities to the world market if production was possible and domestic commercial policies became pragmatic."

He says Australia is transferring its "comparative" advantage, as a low-cost producer with huge reserves, overseas.

"As the competing countries increase their investments in uranium mining, so they lock themselves into maintaining market share in the face of new entrants," he says.

"In simple terms, once you miss the boat the energy required to catch it becomes a disincentive to even trying."

/12828
CSO: 5100/4304

GROUP TO CAMPAIGN FOR HONG KONG NUCLEAR-FREE ZONE

Hong Kong SOUTH CHINA SUNDAY MORNING POST in English 1 Dec 85 p 5

[Article by Vicky Wong]

[Text]

Hongkong should be declared a nuclear-free zone, given recent developments in China and other Asian and Pacific countries.

This is the view of the environmental pressure group Friends of the Earth which is launching a nuclear-free campaign on Thursday.

FOE secretary Ms Linda Siddall said the campaign will kick off at a FOE-sponsored public meeting at which New Zealand Commissioner Frank Muller has been invited to give a talk called "South Pacific nuclear-free zone — a small step to nuclear disarmament."

The meeting is scheduled for 6.30 pm at the St John's Cathedral new hall, where Mr Muller will also be willing to answer questions on the Rainbow Warrior affair.

FOE established a Nuclear-Free Pacific Group in May to work exclusively on peace issues, Ms Siddall said.

The group is affiliated to World Disarmament and has also applied for formal affiliation with Greenpeace.

"There have been a number of developments in the past year or so which indicate that it is not necessarily unrealistic to think that Hongkong should and could become a nuclear-free zone," said Ms Siddall, also NFPG's secretary.

These include:

- A meeting of the six-member Association of Southeast Asian Nations in January to re-activate discussions for a nuclear weapons-free zone for Southeast Asia.
- The indefinite postponement of the first visit to communist China by three US warships, originally scheduled to make port at Shanghai in May. The visit was scrapped when party General Secretary Hu Yaobang said in April China would not accept port calls from ships carrying nuclear weapons.
- A May *Peking Review* article on disarmament, which stated that China had always supported countries which made their territories nuclear-free zones and that all nuclear countries, particularly the superpowers, should respect the status of these zones.
- The formation of a new peace organisation in China in June to promote contacts with anti-nuclear activists abroad.

The Chinese People's Association for Peace and Disarmament has as its president Mr Zhou Peiyuan, a vice-chairman of the Chinese People's Political Consultative Conference, an advisory body to the National People's Congress.

Its eight vice-presidents include three officials of the Communist Party.

● The first international peace conference in China in June, which brought together representatives from 25 countries.

Delegates were told the "most urgent task that must be undertaken to safeguard world peace" is to stop the arms race by the two superpowers and that China needed a peaceful environment in which to concentrate on modernising the country.

● The August signing of the Treaty of Rarotonga for a South Pacific nuclear-free zone by eight Pacific island nations, including Australia and New Zealand.

The treaty area stretches from the Equator to the Antarctic, and from Australia to South America.

Five other South Pacific nations are expected to sign the treaty following constitutional formalities, although one — Vanuatu — has declared it will not do so for at least a year.

"On the face of it, New Zealand's efforts in the South Pacific seem a little remote from Hongkong," said Ms Saddall.

"But if people look at the map, they begin to appreciate how nuclear the Pacific is and how much a part of the Pacific Hongkong is.

"It seems to us at ICOE that given China's stated support for the establishment of nuclear-free zones, this is an ideal time for Hongkong to move towards becoming a nuclear-free zone itself.

"If China will respect Hongkong's autonomy to the extent of not using the harbour for her nuclear-capable ships and will also keep out American nuclear-capable ships, then the nuclear-free Pacific zone can extend to and include Hongkong."

According to Ms Saddall, declaring a place a nuclear-free zone can provide a concept and a statement of intent that people can work towards realising.

She pointed out that as of December last year, 207 nuclear-free zones had been declared in Japan.

In the US, numerous schools and churches have declared themselves nuclear-free, as have many city councils in the United Kingdom.

"It's a symbolic way for people to make their views known," Ms Saddall said.

"It's not necessary that there are actually no nuclear weapons or nuclear powered reactors in those zones.

"It's a way for people to make a statement that they're against nuclear weapons and nuclear power."

Ms Saddall said about 100 US naval ships visit Hongkong yearly and about half of these carry nuclear-weapon systems.

And the recent deploying by the US of submarines armed with Tomahawk missiles in the Pacific has made the area "even more nuclear."

"These are identical to the land based cruise missiles deployed in Europe last year and they are being deployed with almost no protest at all in the Pacific," Ms Saddall said.

There are plans to deploy a total of 250 of these in the Pacific eventually, compared to 464 cruise missiles in Europe, according to Ms Saddall.

This will come on top of about 340 US military bases in and around the Pacific and 10 Soviet bases in Vietnam.

In South Korea, there is a major concentration of US ground and air forces, along with 600 to 700 nuclear weapons.

There are 119 US bases in Japan with more than half based in Okinawa, while the Philippines is home to the naval base of Subic Bay and the largest US base in Asia at Clark.

"The majority of the population here is not conscious of these issues," said Ms Saddall.

"People here don't have control over foreign policy and have on the whole a refugee mentality.

"But there are indications this is beginning to change."

/9317
CSO: 5150/0043

HONG KONG

HONG KONG GROUP BACKS PRC ANTINUCLEAR DEMONSTRATIONS

Hong Kong SOUTH CHINA MORNING POST in English 28 Dec 85 p 8

[Text] The recent anti-nuclear test demonstrations by Chinese students could signify that the Chinese Government is willing to allow more freedom of expression.

Local environmental groups have pledged their support to the students for their attempts to make their views known.

The secretary for the Friends of the Earth, Miss Linda Siddall, said it was a "heartening" indication that the Government in China was more relaxed and more open to democratic expression of people's feelings.

Her environmental pressure group is totally opposed to nuclear testing which they think is unnecessary and would contribute to the arms race.

They also think it is environmentally damaging, even when explosions are underground, Miss Siddall said.

"We fully support the mainland students to persuade their Government to cease such tests," she added.

Echoing her view was the chairman of the Hongkong Conservancy Association, Mr Wan Shek-lun.

He said the nuclear issue has generated much concern all over the world and this has also been the case in communist countries.

And although demonstrations are rare in China, they are one way for people to express their opinions on the issue, he added.

Mr Wan also felt that there was a trend that the Chinese Government was more open to democratic expressions of people's feelings.

Last Sunday, ethnic minority students from China's Xinjiang region staged a demonstration in Beijing's Tiananmen Square to protest against nuclear weapon tests in their region.

Although a Chinese Govenment spokesman said in August that China has conducted few nuclear weapons tests, reports say foreign seismic readings indicate that an estimated 25-plus have taken place at Lop Nur.

/13046
CSO: 5150/0048

HONG KONG

DAYA BAY PROJECT 'WORRIES' ENVIRONMENTALISTS

Hong Kong SOUTH CHINA MORNING POST in English 4 Jan 86 p 6

[Article by Jimmy Leung: "Safety Fears on Daya Bay"]

[Text] An environmental protest group yesterday expressed concern over the price implications of the equipment for the proposed Daya Bay nuclear power plant in Shenzhen

The secretary of the Friends of the Earth, Ms Linda Siddall, was commenting on the signing of the memorandum of understanding between China and Britain's GEC group on the purchase of turbine generators for the plant at a price of £250 million (about HK$2.78 billion).

"We have absolutely no reason to welcome such a project," Ms Siddall said.

She was "extremely worried" over its safety aspects based on the reported discount offered to China by GEC and the French firm Framatome, which will supply two pressurised nuclear reactors at the cost of about US$700 million (about HK$5.5 billion).

The deal between China and Framatome was struck late last month with an agreement signed between the French firm and the Guangdong Nuclear Power Joint Venture Company in Beijing.

Framatome's sister company, Electricite de France (EdF), also signed a memorandum of understanding with China on the overall engineering design of the $27 billion project.

Ms Siddall said it appeared there was a "drastic" price reduction from the British and French suppliers of equipment to the plant which will supply 70 per cent of the electricity to Hongkong in 1992.

In October, she said, it was reported that China wanted a discount of up to 25 per cent off the original price of the British and French equipment.

It was reported then that GEC had been earmarked to provide turbines and other equipment worth an estimated £500 million (about HK$5 billion). Framatome had been assigned the provision of two pressurised-water

reactors, worth a reported US$1.4 billion (about HK$10.9 billion), for the 1,800 megawatt plant.

"Price and quality are always closely linked and we are very concerned," she told the SCM Post.

On the commission date, Ms Siddall said the plant had already been delayed for four years.

Furthermore, Ms Siddall, a lawyer, said no nuclear plant in the world "has been completed in 6½ years," and "the implication is terrifying."

/13046
CSO: 5150/0047

JAPAN

SCIENCE AGENCY REPORTS LAG IN NUCLEAR POWER

OW060419 Tokyo KYODO in English 0341 GMT 6 Dec 85

[Text] Tokyo, 6 Dec (KYODO)--The Science and Technology Agency said Friday that Japan is still lagging far behind other nations in technological developments in the field of uranium enriching and fast breeder reactors. In its white paper on scientific development, the agency also said Japan needs to spend more on basic studies and research in various scientific fields. The Japanese Government shares only 50 percent of the total investment in the field of basic scientific studies while the U.S. Government's burden reaches some 70 percent, it said.

The paper urged the Japanese Government to be more active in spending for scientific development, further pointing out that the West German Government takes care of some 80 percent of total investments in basic studies, the French Government 90 percent and the British Government 80 percent. The average annual spending by Japanese private firms on basic studies and research is only 258 million yen, and even big firms spend an average of only 10 billion yen for the purpose, it said.

In order to help develop creative and revolutionary scientific technology, the government needs to introduce some big development projects that could serve as an "engine" for the private sector, the paper said. It suggested that such projects be introduced in the field of space development, citing the achievements of the U.S. Apollo project, which has led to the emergence of vast amounts of new know-how and by-products. Japan's spending in the space development field is still behind that of the United States, France and West Germany, it said.

Japan has achieved a high standard in the development of new facsimile and video machines and industrial robots even though it needs to make improvements in such fields as uranium enriching, it said.

As many as 95 percent of Japanese firms have shown their willingness to develop new technologies in a way or another and total spending on studies has shown a constant growth rate of about 10 percent in the past 6 years,

much higher than the 4-5 percent growth rate in gross national product, it said. Such spending has been emphasized in the motor, communications and electronics fields, it said.

The paper urged a joint effort by the government, schools and private industries for further development of science technologies, saying universities and government research institutions should take such the initiative.

/9604
CSO: 5160/030

JAPAN

GLOBAL NETWORK TO DETECT NUCLEAR TESTS PLANNED

OW071145 Tokyo KYODO in English 1107 GMT 7 Dec 85

[Text] Tokyo, 7 Dec (KYODO)--The Foreign Ministry will promote the establishment of a worldwide earthquake monitoring network to detect small-scale underground nuclear tests next year. To begin with, officials said, the ministry will seek a budgetary allocation of 35 million yen in fiscal 1986 to set up a system linking eight nations. The initial project envisages the establishment of a seismic observation network in the eight nations to exchange information concerning underground detonations of nuclear devices. The eight countries will be Japan, the United States, Britain, West Germany, Australia, Canada, Sweden and Norway.

The ministry will ask private firms to develop the computer software necessary to detect small-scale nuclear blasts with a force ranging from 20 kilotons to 50 kilotons. The ministry hopes to complete a model plan for an integrated detection network by 1987 for presentation to a disarmament conference in Geneva.

Ministry officials said the proposed network will eventually link 50 earthquake observatories around the world, including the Soviet Union and African nations. A U.S.-Soviet test ban treaty signed in 1974 prohibits underground detonations of nuclear devices with a force of more than 150 kilotons because it is almost impossible to detect tests of smaller scale. The ministry wants to use Japan's advanced earthquake detection technology to help attain the ultimate goal of a total ban on nuclear weapons.

/9604
CSO: 5160/031

JAPAN

COMMISSION URGES FURTHER STUDY OF NUCLEAR SAFETY

OW130153 Tokyo KYODO in English 0049 GMT 13 Dec 85

[Text] Tokyo, 13 Dec (KYODO)--The Nuclear Safety Commission, in a report released Friday, called for expanded study and research on safety of nuclear power stations and transportation of radioactive materials. The annual report by the governmental commission said Japan followed safety guidelines and regulations worked out by other countries when it started nuclear energy development programs in the latter half of the 1950s. But Japan began setting independent safety guidelines in the late 1970s and it has become one of the most advanced nuclear power development countries of the world in the 1980s, the 435-page report said.

Japan now has three basic and nine supplementary guidelines concerning location of nuclear power stations, their design and safety, according to the report, the fourth in a series. The report said commission specialists have been reexamining the three basic guidelines after the accidental radiation leak at the Three Mile Island nuclear power plant in the United States in 1979. There have been no serious accidents involving Japanese nuclear power plants, which supply about a quarter of Japan's total electricity consumption. Japan is banned by law from developing or using nuclear energy for military purposes.

/9604
CSO: 5160/032

JAPAN

YOKOSUKA ANTINUCLEAR DEMONSTRATIONS ON DECLINE

OW140359 Tokyo KYODO in English 0314 GMT 14 Dec 85

[Text] Yokosuka, Kanagawa Pref, 14 Dec (KYODO)--The nuclear-powered U.S. submarine Pintado arrived here Saturday marking a record portcalls made by American N-powered submarines this year. The number of visits to the U.S. naval base at Yokosuka by U.S. nuclear-powered subs this year has far exceeded the previous record of 23 established last year, according to pacifist organizations. Despite the increase in the nuclear subs' portcalls they said, residents of the city have generally remained indifferent to the antinuclear movement. Police said there have not been many people taking part in rallies and demonstrations against visits by nuclear subs this year. Last year pacifist organizations said some 110,000 people participated in such gatherings. Unions have stopped holding outdoor meetings since July.

Among the 30 portcalls, 13 have been made by Los Angeles class subs capable of carrying Tomahawk nuclear cruise missiles, and seven by sturgeon class attack submarines.

A Yokosuka citizens' group opposed to nuclear subs says only about 50 people respond to each protest rally it organizes. A group leader said it is hard to keep citizens interested in the antinuclear movement because they cannot actually see any nuclear weapons to bring home their potential danger.

The U.S. Government maintains a policy of not revealing whether American military ships coming to Japan are armed with nuclear weapons.

/9604
CSO: 5160/033

PEOPLE'S REPUBLIC OF CHINA

FUJIAN PROVINCE EXAMINES FEASIBILITY OF NUCLEAR PLANT

Hong Kong SOUTH CHINA MORNING POST in English 13 Dec 85 p 11

[Text] Fujian province has started a preliminary feasibility study into the construction of a nuclear power plant although it is clear there will be no money for such a project until the next decade.

Mr Zhang Ruiyao, deputy director of the Planning Commission of Fujian province, said: "We have formed a group of experts to look into the project but in view of the financial situation, it is believed we cannot go ahead with it in the Seventh Five-Year Plan which starts next year."

The probable site of the plant is in Quanzhou but it has not been finalised, another official said.

Mr Zhang said electricity shortages in the province average 10 per cent--refuting some press reports which put the figure as high as 30 to 40 per cent.

He said a main problem is an over-reliance on hydro-electric power in the past which has resulted in power shortage during dry winter seasons.

Currently up to two thirds of the power supply comes from hydro-electric plants. The rest comes from coal-fired plants and this is considered unsatisfactory, said Mr Zhang.

The power problem has become more and more acute following the opening of the province five years ago.

But now the province is determined to change its imbalance of power generation by building several coal-fired and oil-fired power plants.

But again there could be problems too.

A latest example is an oil-fired plant in Mawei which is near Fuzhou, the provincial capital.

It was built by French engineers to serve the developing Mawei Economic and Technological Development Zone.

French experts involved in the project said the Chinese wanted the plant to operate in a very short time and so a small-scale oil-fired station was erected.

But when the plant was completed, the provincial authorities found they were unable to buy fuel.

Nevertheless, the authorities are determined to boost electricity supplies to the province and are planning at least three other plants in addition to the Mawei project.

According to Mr Zhang, the power generation in Fujian last year was 6.75 billion kilowatts (units).

(Hongkong with a quarter of the population of Fujian used about 15.3 billion units in 1984).

/13046
CSO: 5150/0045

PEOPLE'S REPUBLIC OF CHINA

AGREEMENT ON DAYA BAY PLANT REACHED WITH FRANCE, UK

Deal with Framatone

Hong Kong SOUTH CHINA MORNING NEWS in English 24 Dec 85 p 1

[Article by Daniel Chung: "Daya Bay Deal Struck with Paris"]

[Text] A deal has finally been reached between France's nationalised nuclear giant Framatome and China on the supply of key equipment for the Daya Bay nuclear power plant.

This follows an agreement by both sides on the price of two nuclear reactors at about US$700 million (about HK$5.5 billion).

A memorandum of understanding, which represents a major breakthrough in the protracted negotiations lasting for more than three years, was signed by the French firm and the Guangdong Nuclear Power Joint Venture Company in Beijing on Sunday.

The two sides are expected to sign a formal contract for construction of the plant by early March.

Sources close to the talks said the French delegation had also finalised the financial aspects of the project--one of the key topics in the negotiations--with Chinese officials in Beijing.

Framatome is providing 100 per cent of the financing for the installation of the two reactors. Interest rates would be based on Organisation of Economic Co-operation and Development levels, at 9.85 per cent.

One source said the date for the formal contract to take effect had tentatively been set for March 3.

Both sides are understood to have made major concessions on the price of the nuclear equipment.

But the source said the French firm was "absolutely satisfied" with the final pricing level for the reactors reached by both sides.

He said the original estimated price of the nuclear equipment at more than $10 billion was somewhat misleading as it included the interest on the loan.

Framatome's sister company, Electricite de France (EdF), which will be responsible for the project's overall engineering design, also signed a memorandum of understanding with China on Sunday.

At present, Britain's General Electric Co is in final talks with Chinese officials on the supply of conventional turbine generators for the plant. British officials are expecting an agreement before the end of the month.

The source said whether Framatome and EdF could sign the formal letter of intent in March would depend on the result of negotiations between China and GEC.

He said it was intended that all the three contracts be signed on the same date.

He said between now and March, Framatome would work out the details of the formal contract with Chinese officials.

The chairman of China Light and Power, Lord Kadoorie, said last night he had no new information on the deal but that he expected reports on the deal were correct.

An official spokesman for CLP, Mr Robert Ip, also said he had no information on the deal.

CLP and China co-own the Guangdong Nuclear Power Joint Venture Co which was set up to undertake the nuclear project.

CLP, which will buy 70 per cent of power from the plant, is aiming at commissioning the plant by late 1991 at the latest to meet Hongkong's 1992 summer peak demand for electricity.

The 1,800-megawatt plant at Daya Bay is expected to cost about $27 billion.

Accord with GEC

Hong Kong SOUTH CHINA MORNING POST in English 3 Jan 86 p 1

[Article by Albert Chan: "GEC Seals Daya Bay Deal with Beijing"]

[Text] A final accord was reached on New Year's Eve between Britain's GEC group and China for the supply of power generators for the country's first commercial nuclear plant in Daya Bay, Shenzhen.

Together with the Sino-French accord signed 12 days ago, the British contract, carrying a price tag of £250 million (about HK$2.8 billion), will put the plant in action in 1992--several months later than the original projected commissioning date.

According the Mr James Cronin, assistant managing director of GEC Turbine Generators,it has been agreed that the commissioning date for the plant's first 900-megawatt unit will be 1992 and the second unit the following year.

The commissioning date was earlier scheduled for the end of 1991, in time to meet Hongkong's summer peak in September 1992.

But one official of China Light and Power Co, which will depend on the plant for power supply in the 1990s, said yesterday there will not be any serious problem if the commissioning date is before September 1992.

He added, however, that this is based on present forecasts which put the annual growth in electricity demand in Hongkong for the next seven years at seven per cent.

GEC and China signed a memorandum of understanding for the supply of turbine generators on Tuesday after more than five years of hard bargaining that involved not only the British company but heads of both states.

Agreement on the nuclear part of the plant was struck on December 20 and 21 when China signed separate memoranda of understanding with Framatome, the French reactor manufacturer, and Electricite de France, the French firm responsible for overall engineering design.

The British and French accords marked a milestone in the project which has been hanging in the balance for the past few months with negotiations at a critical stage.

Chinese Vice-Premier Mr Li Peng met the British Ambassador, Sir Richard Evans, and the French Ambassador, Mr Charles Malo, on Wednesday to congratulate them on the deal.

Describing the memorandum of understanding as a good beginning for the project, Mr Li said he hopes all involved parties will heighten their co-operation to bring to reality what has been written in the documents.

"Its completion will serve the long prosperity and stability of Hongkong," Mr Li said.

Hongkong will purchase 70 per cent of the electricity generated by the Daya Bay plant with the rest going to Guangdong province.

Much time in the protracted negotiations over the last few years has been spent on technical specifications and ensuring compatibility between the British and French equipment, since this is the first time Framatome and GEC have been brought together on a nuclear plant of this magnitude.

Formal negotiations on the project's price and financing began in the middle of last year and sharp differences among the negotiators were apparent.

Talks resumed in October, but again the three sides failed to come to any conclusion.

Mr Robert Davidson, GEC's managing director who is currently in Beijing, told the SCM POST yesterday the tough negotiations continued through the Christmas holidays.

He said his company is "very pleased" with the deal which, according to sources close to the negotiations, is worth "more than" £250 million (about HK$2.78 billion) excluding interest.

The French equipment is worth about HK$5.5 billion, also exclusive of interest.

The next and final hurdle of the project will be the financing arrangements for the British equipment.

It has been learnt that a team of British bankers led by the Midland Bank will go to Beijing shortly to hold talks with the Bank of China on the matter.

The French bankers have already reached agreement with the Chinese on financing.

A senior Chinese official said detailed site plans for the plant, which will be prepared by the French and British companies, are expected to be available by April and excavation work can begin then.

The present thinking involves signing letters of intent with Framatome and GEC in early March and formal contracts a few months later.

But the exact date of contract signing is undecided.

/13046
CSO: 5150/0046

CANADA

GOVERNMENT TO CUT RAW URANIUM EXPORTS IN HALF

Vancouver THE SUN in English 8 Nov 85 p A22

[Text] OTTAWA (CP) — Exports of raw uranium ore will be cut by more than half as Ottawa toughens its policy to provide more work at Canadian processing plants.

Canada is the world's largest uranium exporter. The processing industry, centred on government-owned Eldorado Nuclear, is a $50 million-a-year business employing about 500 workers. Eldorado operates the country's only uranium refinery at Blind River, Ont., and the only processing plant at Port Hope, Ont.

Mines Minister Bob Layton redefined the policy in a letter last month. Canadian government policy has long required that all exports must be processed in Canada as long as Eldorado can handle the job.

But in recent years, more than a quarter of uranium shipments to foreign customers involved raw ore, the documents show.

Between 1979 and 1983, the government granted 16 exemptions allowing the export of about 9,000 tonnes of raw ore.

Ottawa has tried for about a year to keep secret all information about the number of exemptions, arguing it was protecting trade secrets. The information was only released after the Canadian Press complained to the government's information commissioner. Officials had said last year that exemptions to the policy were rare.

Under the restated policy, the government estimates that shipments of unprocessed ore will fall to about 10 per cent of total export orders.

"I think we're reasonably happy with the policy," Ron Dakers, an Eldorado vice-president, said.

Believing that uranium exports would increase and that the policy would be honored, Eldorado began to expand its facilities, building its refining plant in 1983 and doubling the capacity of its processing plant.

The increasing number of exemptions was partly responsible for layoffs at both plants, Dakers said. He said Eldorado could have done some of work, but was not given the opportunity to even make a bid.

The policy was strained by the start of operations last year at the Key Lake mine in northern Saskatchewan, the world's largest and richest uranium ore body. The Key Lake consortium found it easier to compete in a tight world uranium market if it could avoid the Canadian requirements.

/12379
CSO: 5120/27

CANADA

LICENSE SOUGHT FOR COMMERCIAL NUCLEAR SUBMARINE

Ottawa THE CITIZEN in English 29 Nov 85 p A4

[Text]

A Canadian and French consortium planning to give Canada the world's first nuclear-powered commercial submarine has made its first approach to the Atomic Energy Control Board for a reactor licence.

The board announced Thursday that International Subsarine Transportation Systems has filed a notice of intention to submit a formal application for a licence early next year.

Because the ship is intended for operation in Canadian waters, it must get approval from the board to run its nuclear power plant.

The vessel, to be known as the *SAGA-N*, "will be the largest commercial submersible ever launched," Ed Dunn, president of Halifax-based International Submarine Transportation Systems, said in an interview.

The sub, whose hull is now being finished at a shipyard in Marseille, will be 38 metres long, will weigh about 700 tonnes and will carry a crew of 15.

The completed project will cost about $130 million. Although Dunn said the company might eventually ask for government help, it now is being financed without a drop of federal money.

The sub will be launched from Marseille next October with an unconventional type of non-nuclear engine and after sea trials will be brought to Canada in late 1987.

It will then be fitted with a nuclear power plant modelled on the small, Slowpoke research reactors used by several Canadian universities. Addition of the reactor and engineering changes to accommodate it will take about 60 weeks, Dunn said.

The reactor is being built by ECS Energy Conversion Systems of Ottawa, one of the partners in the consortium.

ECS vice-president Allan Kastner said ECS has never built a reactor before and admitted the challenge is daunting.

The reactor will produce about 1.5 megawatts of power, much more than is produced from the conventional Slowpoke. But compared to nuclear generating plants on land which produce hundreds of megawatts and to power plants used in military subs, the Saga reactor is a baby.

Dunn said the main purpose of the vessel, which can dive to about 600 metres and then deploy a team of six divers, will be to explore the seabed of Canada's continental shelf below the ice-pack.

/12379
CSO: 5120/27

GERMAN DEMOCRATIC REPUBLIC

ECOLOGICAL ASPECTS, RELATIVE SECURITY OF NUCLEAR ENERGY CITED

East Berlin TECHNISCHE GEMEINSCHAFT in German No 12, Dec 85 p 27

[Article by Dr Roland Maier, GDR Academy of Sciences, Institute for Sociology and Social Policy: "Ecological Aspects of Nuclear Energy--Environmental Planning"]

[Text] Calculations by Soviet scientists indicate that the world's consumption of energy will roughly double from 1980 to the year 2000. In some cases, other predictions are even considerably higher. The reasons for this are, above all, further progress in mechanization and automation processes, and also an increase in the world's population and buildups in the energy base in the developing countries.

Currently there are still considerable reserves of fossil sources of energy such as petroleum, coal, and natural gas for dealing with our present energy needs. But what is problematic is how the enormous increased demand for energy expected in the future can also be satisfied at an economically and ecologically acceptable cost. Today, the tempo in opening up new fossil energy reserves is no longer enough to assuage in the future the constantly swelling "energy hunger." Thus, for example, by the turn of the century only about 2 billion tons of new recoverable petroleum resources will be discovered annually--but current world consumption already amounts to 3.2 billion tons per year.

Gradual Substitution

At present, the generation of energy by means of nuclear fission is the only technology that can meet on an industrial scale a large percentage of the energy requirements that are expected.

The expansion of nuclear-energy production is taking place on a systematic and long-range basis in the GDR as well. Assuming our present output level and the acceptable economic conditions of today, our reserves of brown coal will last for about 100 years more. But in this connection the fact must be considered also that in the GDR, brown coal is the only available source of carbon in relatively large quantities and therefore it must be kept on hand also as a raw material for the chemical industry. Accordingly, if there is a further rise in the brown coal output to much beyond 300 million

tons per year by 1990, the additional increase in energy requirements will have to be met primarily by way of nuclear energy.

At present, about 12 percent of the electric-power requirements of the GDR are being met by nuclear power. But by the turn of the century, 40 percent of our electric power should already be produced by nuclear facilities.

Energy production by means of nuclear power is also associated with questions about the possible dangers and ecological problems involved.

The Risk Is Acceptable

The cycle of the nuclear-power industry commences with the mining of uranium ore. If there is an improper storage of the large amounts of contaminated media resulting from the processing of the ore, there is a danger that radioactive substances may lead to a pollution of water bodies. But on the whole, such quantities of released radioactive material are very small. Here is a comparison in this regard: From the mineral fertilizers used in the FRG in 1977 the radioactivity dose released was about 2 to 3 times more than that released from the excavated material that had been produced from the recovery of the uranium consumed in the FRG in the same year.

In the operation of nuclear power plants (NPP's), radioactive substances are emitted into the atmosphere along with the vent air and into the drainage canals with the waste water. Based on many years of operating experience with about 200 NPP's throughout the world, it can be estimated that the overall additional radioactive strain on the environment resulting from this comes to only about 25 percent of the average natural radiation exposure.

In considering the interaction between nuclear energy and the environment, it is evident that the removal of the heat generated in cooling the reactors may become a problem. In the cooling system most commonly used at present--river-water cooling--the amounts of water needed are taken from a body of water and after being heated up by about + 10° K are fed back into this water body. With the use of this cooling method alone, future water requirements would rise enormously, and just for the FRG itself they would amount to about 10 times the water circulation of the Rhine in the year 2000. Therefore it is urgently necessary to focus on evaporative cooling and dry-air cooling.

Extensive Safety Features Offer Protection

As more than 20 years of operation have shown, nuclear power plants have a level of engineered safeguards that is unmatched except in the space-travel sector. Thus, safety systems are generally equipped with redundant backup systems. From risk studies it follows that non-nuclear disasters--that is, natural events such as earthquakes, tornadoes, and accidents such as airplane crashes, dam bursts, and so forth--have a considerably larger probability of occurrence than nuclear catastrophes. Probability calculations with 100 NPP's now in operation showed that non-nuclear damage

occurs at a frequency up to 10,000 times greater than damage from nuclear causes.

Waste disposal from nuclear power plants--that is, above all the removal of highly radioactive waste from the fuel cycle and the isolating of these residues from the biocycle--is a serious problem. Deep storage in geologically stable formations is regarded as an acceptable solution for disposing of radioactive wastes. Salt deposits, granite rock, and strata of clay are generally suitable for this purpose. On the other hand, the practice engaged in by capitalistic states of submerging within the sea weakly and moderately active wastes in steel and concrete drums is extremely dangerous from an ecological standpoint.

So far, there is still no complete set of analytical tools for a comparative assessment of different energy-generation facilities. Starting with emission, in order to have the most comprehensive comparison possible of various energy conversion methods the resulting adverse effects and damage must be systematically analyzed. In this regard, with power plants running on coal and oil the emissions of sulfur dioxide and other pollutants must be considered in particular. A 3,000-MW power plant running on crude brown coal causes the following releases on an annual average when there is no contaminant separation: 20,000 tons of dust, 200,000 tons of SO_2, 2 million tons of ash, and 40 million tons of CO_2.

Practically Emission-free

As an important indication of such adverse ecological effects, let us just mention here the carrying by air currents of sulfur dioxide over long distances and the associated damage to forests and bodies of water. Also closely connected with such emissions is the emission-caused damage to buildings, equipment, and so forth.

Total losses arising from corrosion represent about 1 percent of the gross national product of the GDR--which was almost 8.5 billion marks in 1981. Furthermore, groundwater-lowering measures on an enormous scale are necessary as follow-up actions in coal mining, and these actions may be associated with negative consequences to agriculture and forestry as well as to the supply of drinking water and industrial water.

As for the emission of radioactive substances, Soviet energy experts have determined that the natural radioactive substances from the earth's crust that are necessarily uncovered in supplying conventional power plants with fossil fuels produce the same level of radiation exposure as nuclear power plants. A comparison has been made concerning relative adverse pollutant effects, with the same electrical output being assumed for the various types of power plant in each case. Based on this comparison, in terms of pollutant emission the generation of energy from NPP's is more satisfactory by a factor of 1,000 than generation from coal and oil power plants, and more favorable by a factor of 100 than that from natural-gas power plants.

12114
CSO: 5100/3014

YUGOSLAVIA

PLANNED NUCLEAR POWER PLANT CONSTRUCTION DESCRIBED

Zagreb VJESNIK (SEDAM DANA supplement) in Serbo-Croatian 7 Dec 85 pp 2-3

[Article by Salih Zvizdic: "Yugoslavia on Line"]

[Text] Yugoslavia has finally made a firm decision to buy a nuclear power plant (NE). And not just one, but four, and all four the same as the first, which is to go under construction in 1988 at Prevlaka on the Sava, some 30 km downriver from Zagreb. The decision on the program for construction of four NE was made after nearly 10 years of various analyses and the proceedings of commissions, among them the well-known Kraigher Commission.

The basic propositions as to what we desire from the nuclear program are mostly well known. An agreement was reached at the level of the republics and provinces that all four NE must have the same nuclear fuel cycle and a standardized system of reactors. Within that context of what was known, there remained many unknowns, and the answers can come to us only from the final analysis of the bids of foreign contractors who will help us to build the power plants.

As soon as they study all the bids our specialists will decide whether it will be nuclear power plants using natural or enriched uranium. If they decide on natural uranium, then in that case a choice has to be made between two systems of heavy-water nuclear reactors, one of them Canadian (CANATOM), and the other West German (KWU, Kraft Werk Union). If the specialists opt for light-water nuclear reactors, then there are three types of such reactors involved, and there are several bids for them. There is practically no difference in efficiency and commercial utilization of these nuclear plants, so that the preference will go to suppliers offering better credit terms and other conditions. Nor has the method of financing, in dinars and foreign exchange, yet been determined for the four nuclear power plants. Nor are the sites known except for Prevlaka.

The international competition for construction of four nuclear power plants in Yugoslavia was advertised on 25 October 1985 in SLUZBENI LIST SFRJ [OFFICIAL GAZETTE OF THE SOCIALIST FEDERAL REPUBLIC OF YUGOSLAVIA]. So far the documentation has been purchased by eight of the world's suppliers, two each from Japan and France, one each from the United States, Canada, Italy, and West Germany, and the bid of one other firm from the United States is expected, as

well as bids from the USSR and Sweden. Ten domestic work organizations have also applied: "Djuro Djakovic" of Slavonski Brod, "Jugoturbina" of Karlovac, INA and "Rade Koncar" of Zagreb, "Energoinvest" of Sarajevo, MINEL of Belgrade, "Gosa" of Smederevo, MIN of Nis, "Slovenija ceste" of Ljubljana, and "Metalna" of Maribor. The foreigners purchased the documentation at $20,000, and domestic bidders for 600,000 dinars.

"I can say with full responsibility that this international competition is by no means a 'reelection of a well-known candidate,' but an open bidding in which all have equal prospects, but this job will go to whoever makes the best offer," says Zarko Petrovic, engineer, coordinator of the working group for construction of the "Prevlaka" NE, but also one of those responsible for building the other nuclear power plants.

For and Against

Aside from the group of specialists and individuals who oppose construction of nuclear power plants on ecological and safety grounds, there is also a group of specialists in Yugoslavia who oppose it on economic and financial grounds, as shown by the discussion held on 19 November in the Center for Engineers and Technicians in Belgrade. These others are afraid of new "Obrovaces" and "FENI's."

All that can be offered the ecologists is the evidence, in addition to the more than 300 existing nuclear power plants in the world, and the additional 126 that are now under construction, is that the new nuclear power plants are much safer than the first ones. The statistical data on the safety of these power plants is quite convincing, especially since there have been no very serious accidents even in the first "child's steps of nuclear power plants," with the exception of the American Three-Mile-Island plant. At the same time, in certain countries the Green Movement, which has taken a position of fierce opposition to the construction of nuclear power plants, has in addition to its ecological coloring, a very strong political coloring as well that is independent of ecology.

Here are some figures on the number of nuclear power plants in the world: the leader is the United States with 86 NE, the USSR with more than 45, France 41, Great Britain 32, Japan 31, West Germany 19, Canada 16, Sweden 10, Spain 7, GDR 6, Bulgaria 5 (they are completing a sixth on the Danube), Switzerland and Belgium 5 each, Finland and Czechoslovakia 4 each (another 4 are under construction in Czechoslovakia), Italy 3, Poland and Hungary 2 each, Yugoslavia 1...and so on.

The answer for those "afraid" about the economic and financial future of large nuclear investment projects, and they are above all demanding that natural resources of other sources of energy (coal, water, and petroleum) be used first, since they are more profitable, is that the nuclear power program in our country is an expression "not only of pure economic logic, but in fact of pure economic necessity." Even much more advanced countries are not yet counting seriously on power obtained from windmills and solar energy, and the countries with a surplus of petroleum, coal, and gas are speculating more and more with

those commodities. Coal in Yugoslavia will only last a few more decades, and even today we do not have enough petroleum and gas. Moreover, there remains very little unutilized hydroelectric potential in our country. In connection with all of this we must assume an annual growth of power consumption between 3.5 percent (the pessimists) and 8.5 percent (the optimists).

Croatia is subject to the greatest energy threat in Yugoslavia. Coal from Istria is used by TE [thermal electric power plant] "Plomin," and all of it will be gobbled up by the new TE "Plomin 2." It is not possible to count in a commercial way on the small reserves of coal in the Zagorje mines, since among other things they are mostly underwater. As for hydropower, Croatia can count on only an additional 1,000 MW, and that would be at 36 sites! Those sources could yield an additional annual output of 4 billion kwh, but even this year our republic is consuming about 14 billion a year, while in the year 2,000 it will be consuming 29 billion!

"Nuclear power has not entered Yugoslavia by the back door, but quite openly and after many discussions. There are the resolutions of the SFRY Assembly in 1977 on this question, and then the agreement among the republics and provinces on the place of nuclear power in Yugoslavia's energy policy, which dates from 1982, and then many commissions and projects, and all of this was made known to many people and the broad public," Zarko Petrovic said.

Who Is Paying How Much?

Aside from Montenegro, which still has sufficient unutilized hydropower, and Kosovo, which has sufficient reserves of coal, the other five republics and the Province of Vojvodina agreed in 1982 that by the year 2003 they would jointly build a total of four NE, each with a capacity of 1,000 MW (for the sake of illustration the present NE "Krsko" has a total power of 664 MW, Slovenia and Croatia each being entitled to 332 MW).

There have been many discussions on the topic of how many nuclear power plants, 12, 8, or 4, and then whether reactors should be chosen with greater or smaller capacity (many favored a capacity of 440 MW). The view finally prevailed that we should decide on 1,000 MW primarily because of the lower price per unit investment, although there does exist a mild alternative to this solution.

A calculation shows that the four NE, together with the use of energy from other energy resources, could cover the growth of consumption up to the year 2003. The first at Prevlaka will be built by 1995, the second by 1998, the third by 2001, and the fourth by the year 2003. But since the five republics and the Province of Vojvodina possess differing sources of "conventional" energy, their share in financing the construction and use of power from these power plants also varies. Thus Bosnia-Hercegovina, Macedonia, and Serbia proper will each have a 10-percent share of the financing, Slovenia 12 percent, Vojvodina 21 percent, and Croatia 37 percent. These percentages at the same time indicate the reserves of energy sources in those republics and that province.

Aside from the location of NE "Prevlaka," which has been clearly defined, the others have been only suggested. One more nuclear power plant will be built in Croatia, and that at one of these three sites: Vir near Zadar, Vrankso Jezero, or the island Pag. The others will most likely be built near Dalj or Bogojevo (two neighboring places on the banks of the Danube), and then at Smederevo on the Danube, while in Macedonia Krivolak on the Vardar (downstream from Titov Veles) has been chosen.

Slovenia did not agree to go half-and-half with Croatia on the 1,000 MW from NE "Prevlaka," but will take only 332 MW (the same as their half of NE "Krsko"), and since Croatia has taken 500 MW, another 168 MW will be available. Bosnia-Hercegovina, Vojvodina, and the central heating system of Zagreb are potential candidates for those 168 MW.

We are building four nuclear power plants under rather favorable financial and credit conditions in the world, quite different from those at the time when Krsko was built (1974-1981), when Yugoslavia went out looking for contractors and creditors for the work, while today--because of the crisis of nuclear energy in the world--they have come looking for us. The nuclear energy crisis was not caused by a failure of nuclear power in the world, but by surplus capacity for generating electric power in the advanced countries. For example, in the United States in 1982 surplus power generating capacity amounted to 33 percent, and at the same time the annual growth of consumption fell from 6 to 2 percent because of the higher cost of energy. All of the Yugoslav tenders in the international competition for four nuclear power plants in Yugoslavia explicitly stated that the company which takes responsibility for this work must guarantee not only to equip the reactor and a uniform nuclear fuel cycle, with all the details of production and fuel consumption, but must assume an obligation to include the most recent scientific advances in the construction to keep up with the development of nuclear power plant construction. In addition, the bidder must pass on the knowledge and experience of the most up-to-date technology to Yugoslav work organizations, some of which ("Dj. Djakovic," "Metalna," "R. Koncar," "Jugoturbina," and others) already have experience in building the NE "Krsko." In addition, it is assumed that our work organizations could produce and install even about 80 percent of the equipment for the fourth power plant. In addition to that, plans call for gradual independence with respect to the fuel cycle as well.

According to present calculations, the price of one nuclear power plant, if we had cash, would be about $1.8 billion. But if we take credits into account (it is assumed that about 40 percent would be borrowed abroad), and then the foreign exchange components in the equipment which our factories will make, and then the interest during the period of construction and the regular interest, the price of the four nuclear power plants would range at about $15 billion. The debt would be repaid over a period of 15 years from the time each plant goes on line. From a commercial standpoint our demand that the foreign contractors take 85 percent of payment for equipment and work items in the form of deliveries of various goods is very challenging.

In the present situation those 85 percent seem to be the most complicated problem for us, since the foreign companies accept that demand of ours in

principle. This is a great opportunity for our economy, but the question is how to take advantage of it: Our past experience in this regard has not been brilliant.

The Experiences of Krsko

As conceived by specialists in the electric power industry, the dinars to build the four nuclear power plants would have to be furnished "exclusively through the regular mechanism of assembling resources for development of the electric power industry" (through the institution of the present self-managing communities of interest), since no sort of domestic banking or commodity credits come into consideration under the conditions of today's high interest rates.

According to this conception, the foreign exchange would be furnished by exporting goods, and the electric power industry would pay the exporters dinars for the exchange they have earned in that way. ("Electricity is built into every production operation," Z. Petrovic explains.) A specific "Yugoslav model," which in fact was mentioned in the recent resolutions of the SFRY State Presidency, has been built on that kind of financing and distribution of the power from the future power plants.

In any case, advantage will be taken of the experience gained in the financing and operation of our first nuclear power plant. The total investments in that NE amounted to about $515 million. But by this point that amount has grown to $1.15 billion, but because the debt has been rescheduled at the level of the SFRY, the principal is still not being paid off, but only the interest, which amounts to about $20 million a year. In addition, a third of the nuclear fuel is changed annually in accordance with the usual technology, and about $25 million are paid for that.

In spite of losses, our first plant at Krsko has a high degree of capacity utilization (about 85 percent), and as many as 116 power plants in the world have recorded poorer operating results. All of those elements, which Ivo Medvedec, engineer and Croatian representative in the duet of directors, spoke about at length were taken into account in designing the financial package for our nuclear program up to the year 2003.

Our specialists are looking attentively at the possibility of construction after the Canadian-Turkish model, since the Canadians offered to build a nuclear power plant for the Turks at Akkuyu with their own capital, and then the Turks would allow them to dispose of 60 percent of the power generated at that plant as they chose. The Canadians would sell that power at the going rates of power from conventional sources to the Turks or abroad. When the nuclear power plant is paid off in that way, and that takes approximately 15 years, it would become Turkish property. (Incidentally, the life of a nuclear power plant is about 30 years, and then its fuel equipment needs to be replaced.)

This model deserves attention because of the financial plan, which is rather painless for the host country in the investment phase. That model, should we decide on it, might certainly come into account with other equipment suppliers as well.

The nuclear program has started out in quite serious fashion. The international competition lasts until 25 June of next year, and then a special commission of experts will by the end of the year propose to the Federal Executive Council its choice of fuel cycle and reactor, and construction would begin shortly thereafter. This scheduling of the work is firmly fixed at present. Any postponement or lag would be expensive for us; the annual growth of electric power consumption is even today greater than the possibility of producing it at the facilities which have been built.

7045
CSO: 5100/3013

BRAZIL

O GLOBO: NUCLEAR MISSILES POSSIBLE IN 5 YEARS

PY150013 Rio de Janeiro O GLOBO in Portuguese 13 Jan 86 p 14

[Text] Brasilia -- Brasil could have nuclear missiles in 5 years. A space science cooperation agreement signed with the PRC last year will make it possible for Brazil to develop solid-fuel offensive missiles with nuclear warheads, which are technologically similar to missiles manufactured in the United States in the 1960s.

Under that agreement, Brazil will transfer solid-fuel technology to the PRC. In return, the PRC will transfer to Brazil advanced technology on liquid fuels and rocket-guidance systems that have been developed in the past 20 years. With the PRC technology and fuel, Brazil could manufacture a nuclear missile in a few years.

At present, the PRC nuclear shield is composed of liquid-fuel missiles, capable of hurling heavy payloads at greater distances than those possible with solid-fuel rockets. Their drawback, however, is that the liquid-fuel rockets cannot be safety stored because the liquid fuel is unstable and can explode easily. The difference in launching time between the liquid-fuel and the solid-fuel rockets is noticeable. A Minuteman III, one of the most modern U.S. missiles, can be launched in 2 minutes, while the CPR-SSBM-1-N, as the most powerful PRC missile is called, requires 20 minutes, minimum.

In 20 minutes, a ballistic missile travels half the distance of the earth's circumference, so the PRC atomic shield is militarily ineffective.

The Brazilian solid-fuel would make a difference for the Chinese. In return, the program being developed by the National Institute of Space Research in Brazil will gain an appreciable advantage: A rocket that is capable of carrying a 1,000-kilogram satellite up to operational altitudes.

The cooperation agreement has a military aspect that is important, because the space rocket guidance system with minor modifications can be used for offensive missiles. If this guidance system is added to the solid-fuel know-how the Aerospace Technology Center (CTA) has developed, Brazil will have missiles that are accurate enough for military use.

This plan however, has two obstacles: in Brazil there is no enriched uranium or plutonium for the manufacture of an atomic bomb, which is not under the control of international organizations, and the Brazilian Government has no intention of developing, through the Armed Forces, specific research with this goal in mind.

The Navy Research Center, in cooperation with the Institute of Nuclear Research of Sao Paulo University, is working on a process of enriching uranium through laser rays. The material obtained would be used in a nuclear submarine carrying torpedoes and antiship missiles. So far, the practical results obtained have been few, although the project for a 12-megawatt naval reactor has been completed.

The Air Force enriches uranium in Sao Jose dos Campos by ultracentrifugation methods. The idea is to use this process to manufacture fuel for the artificial satellite which will be launched from the Alcantara base in Maranhao, in 1987.

According to nonofficial data leaked by the CTA, this process of producing enriched uranium is already economically feasible, with even greater productivity than the fuel sold by the Kraftwek Union to Brazil through a nuclear agreement signed with FRG at the end of the Geisel administration.

On the other hand, the Army is trying to produce fission nuclear reactors, using plutonium as fuel, according to the newest pure physics techniques.

Of all these programs, only that of the Air Force could have any impact on the production of a nuclear device. However, according to nonofficial sources, this could only be done if a nuclear power appeared in the Southern Hemisphere -- read Argentina and South Africa.

Only in these circumstances would the CTA, which is not under international control, begin to produce solid-fuel missile warheads, based on the VLS -- The Brazilian space rocket -- which will be launched in 1987.

/12858
CSO: 5100/2035

DHAKA ENERGY MEETS ADVOCATES NUCLEAR POWER INCREASE

Ershad on Rooppur Project

Dhaka THE BANGLADESH TIMES in English 22 Nov 85 p 1

[Text] President and Chief Martial Law Administrator Lt Gen H.M. Ershad said on Thursday that the Government was sincerely working for the implementation of Roopur nuclear power project.

"It has not been shelved," President Ershad said, and added that efforts were being made for pooling assistance from the friendly countries for the implementation of the project. "We have made considerable progress in the regard."

President was inaugurating the four-day international conference on energy development planning for Bangladesh at the Institute of Engineers auditorium.

President Ershad said nuclear power project of Bangladesh was absolutely for peaceful purposes. It was designed to help meet the country's energy requirement with a view to improving the condition of the people.

President Ershad appealed to the friendly countries to assist Bangladesh in the implementation of Rooppur nuclear power project.

Participants' Comments Reported

Dhaka THE NEW NATION in English 22 Nov 85 pp 1, 8

[Text] Participants in an international conference on "energy development planning for Bangladesh" yesterday suggested immediate appropriate steps for introducing nuclear power in the country so as to make 'cheap electricity available at the doorstep of common man.'

They said nuclear power was not only a viable and attractive proposition technically and economically but also a foreign currency saver as it would reduce dependence on imported energy significantly.

Presenting their paper jointly on 'need and choice of power reactor for Bangladesh' at the second technical session on the second day of the four-day conference, Anwar Hossain, M.A. Qualyam and C.S. Karim of Bangladesh Atomic Energy Commission said introduction of nuclear technology could give a boost to the overall economic activities of the country.

In all five different papers on different aspects of energy were presented by Dr Saifur Rahman, Mr S.T.S. Mahmood, Mr Q. Ahsan, Prof A.M.Z. Huq, Dr Milton Levenson and Dr Anwar Hossain, Mr M.A. Qualyum and Dr C.S. Karim at yesterday's second session which was chaired by Prof D.P. Sengupta and co-chaired by Mr M.A. Rahman.

Pointing to the usefulness of nuclear power, Mr C.S. Karim said its share in electricity generation in fact acted as a vital mechanism in overcoming the energy crisis and moderating the energy pricing.

He cited an instance and pointed out that nuclear power stations commissioned between 1972 and 1982 helped reduce the demand for oil by about 550,000 ton per day which is roughly one quarter of the total reduction in oil production by OPEC countries.

By early 1984, total annual electricity power generations of all the nuclear power plants of the world exceeded one trillion kilowatt hours. Had the same energy been produced by oil-fired plants, this would have required a daily consumption of 700,000 tons of oil, he said.

The paper observed that the natural gas resources of Bangladesh would not be sufficient to generate the required electricity after meeting its demand for industries, domestic commercial sectors and particularly production of fertilizer and underlined the necessity of diversifying electricity generation sources.

It also pointed out that for a coal-fired plant with a capacity of 300 mwe running at average plant factor of 70 percent the transportation system of the country would have to be equipped to handle and transport about 800,000 tons of coal annually if local coal was not available by that time.

Oil under no circumstances can complete with either gas, coal-fired or nuclear power generation, the paper said, adding "it therefore, almost a compulsion for Bangladesh to introduce nuclear power immediately if the situation has to be improved in real sense."

The experts of the Atomic Energy Commission referred to the experience of USSR, Argentina, India and Finland which had shown technical and economic viability of reactors in SMPR range and said although the initial capital investment in case of nuclear power plant is higher compared to a conventional plant, the lower fuel cost and the associated economic advantage outweigh its disadvantage of higher forecast.

/9317
CSO: 5150/0044

REPORTAGE ON FAST BREEDER REACTOR AT KALPAKKAM

Dedication, Rajiv Speaks

Calcutta THE STATESMAN in English 17 Dec 85 pp 1, 9

[Text] MADRAS, Dec. 16.--"Mrithyorma Amritamgamaya" (lead us from death to immortality), intoned Mr Rajiv Gandhi while dedicating to the nation the fast breeder test reactor and the 235 MW second unit of the Madras atomic power plant at Kalpakkam, about 50 km from here, today.

Splitting of the atom had given immense energy to mankind. "This energy should be used for human welfare and not for destruction", the Prime Minister said and reaffirmed India's policy of using nuclear energy only for peaceful purposes.

"Our scientists have built at Kalpakkam a new monument, a new temple of modern India, a symbol of our commitment to progress", said Mr Gandhi and added "The question before us today is whether we would be able to deal with what we have created with our scientific strength".

Planting a banian sapling to mark the occasion, Mr Gandhi rechristened the reactor research centre as Indira Gandhi Centre for Atomic Research in the presence of a galaxy of nuclear experts, both national and international, including Dr Hans Blix, Vienna-based director-general of the International Atomic Energy Agency, Dr Munir Ahmed, Chairman of Pakistan's Atomic Energy Commission, and Dr Georges Vendryes, Advisor to the French Atomic Energy Commission.

Recalling the Delhi declaration on the peaceful uses of nuclear energy signed by leaders of six nations, including Indira Gandhi, Mr Gandhi said whether it was the Madras atomic power plant, the fast breeder test reactor or any other reactor, India was committed to their uses for constructive purposes only. "Our abhorrence to nuclear weapons and war is total", he declared.

Commissioning of the Rs 68-crore fast breeder test reactor, designed entirely by Indian scientists and using indigenously mixed carbide fuel with a plutonium and uranium base, instead of enriched uranium, marks India's joining the select band of six countries--the USA, Soviet Union, France,

Britain, West Germany and Japan--possessing such sophisticated technology. China is yet to venture into the fast breeder field.

Mr Gandhi said the progress achieved in atomic energy in the country should reach every sector of the economy--industry, agriculture and research and development. Such progress must be used as a vehicle for spreading the scientific temper and for the uplift of the people, he said.

Mr. Gandhi said India, proposed to ensure that at least 10% of the country's energy generation was from nuclear source by the year 2000, and hoped the fast breeder test reactor would give the necessary impetus to achieve this goal.

Recalling the vision of the late Homi Bhaba, who had first thought of the fast breeder technology, Mr Gandhi said the country should take a leap ahead so that it could catch up with the next generation technology.

Mr Gandhi congratulated the nuclear scientists for their achievements and said the track record of the Department of Atomic Energy had been good. It had passed on the fruits of research and development to the industry and collaborated successfully with the private public and joint sectors for indigenous design and fabrication.

Nuclear energy had given us "cheap, safe and clean power", said Mr Gandhi. Even in the field of preserving the environment, the country's nuclear scientists had established a good record.

"At Kalpakkam, you have created energy from the atom and not far away from here, at Mahabalipuram, our forefathers had built the shore temple to harness spiritual energy", Mr Gandhi said. "The question before us today is whether we will be able to deal with what we have created with our scientific strength", he added.

Though the Department of Atomic Energy had come a long way from commissioning of the Rajasthan atomic power station to that of the Madras atomic power plant, there were areas where the progress left much to be desired, Mr Gandhi said. These included dependability, rectification of faults, management systems and inventory controls and hoped the scientists would pay special attention to rectify the shortcomings.

Dr Hans Blix described the opening of the Indira Gandhi Centre for Atomic Research as a milestone in the development of nuclear science and technology whose significance extended far beyond the frontiers of India. "It is a truly remarkable achievement and shows what can be accomplished by a developing country in the nuclear sphere when the determination and dedication is there. Nuclear power and nuclear science are not for the rich countries alone", he said.

Mr Georges Vendryes said plutonium-uranium carbide held great promise for nuclear power generation. "India could be world leaders in this fuel development and France is very much interested in the results of the fast reactor at Kalpakkam".

Mr Vendryes said if India wanted any collaboration with France on transfer of technology, his country was ready for discussions.

Dr Munir Khan disclosed that Pakistan was building a light water 900 MW nuclear power plant with enriched uranium as fuel, which theoretically made the country capable of making nuclear weapons. He said the enriched uranium would be made available from internal sources.

Dr Raja Ramanna, Chairman of the Atomic Energy Commission, spoke of India's nuclear programme and the role of the fast breeder reactor in future nuclear energy development plans. He said that Indira Gandhi would ever be remembered as the main architect for the growth of science and technology in India, particularly in the field of nuclear energy.

Dr C. V. Sundaram, Director of the Reactor Research Centre, explaining the salient features of the fast breeder test reactor, said the sodium-cooled, plutonium-fuelled loop-type reactor was designed to produce 40 MW of thermal power and 13 MW of electrical power. He added that power generation was not the only goal in building the test reactor.

The test reactor was being operated at low power in order to measure the reactor physics characteristics of the core which uses a new carbide fuel. The reactor physics measurements being made and also to be made later were expected to yield a wealth of information which would be used to develop the capability for fast reactor design studies in India.

Dr Sundaram said a commercial fast breeder reactor could generate power at competitive prices only if the maximum possible energy was extracted from its fuel bundles.

The Tamil Nadu Governor, Mr S. L. Khurana, and the Chief Minister, Mr M. G. Ramachandran, were among those who attended the function.

After the dedication ceremony, an international symposium on "fast breeders as a future source of power" was held at Kalpakkam in which, apart from the Secretary-General of the International Atomic Energy Agency, representatives of the six countries having on-going fast breeder research programmes, besides scientists from many Asian countries, including Pakistan, Bangladesh, Indonesia, the Philippines and Malaysia participated.

The Prime Minister arrived in Madras at noon on a nine-and-a-half hour visit after participating in the World Kannada Conference in Mysore.

After dedicating to the nation the fast breeder test reactor and the second unit of the Madras atomic power plant at Kalpakkam, he followed it up by dedicating the Rs 170-crore expansion project of the Government of India owned Madras Refineries at Manali, on the outskirts of the city, which increased its crude processing capacity from 2.8 million tons to 5.6 million tons a year.

Speaking at the MRL function, Mr Gandhi disclosed that RS 12,500 crores would be spent on oil exploration and development during the Seventh Plan, which

was twice the allocation for the previous plan. "We must now ensure that we get good returns on this investment", he said.

Mr Gandhi said the country would be self-sufficient in energy by 1990. He called for fuller capacity utilization and better fuel efficiency methods to meet the growing energy needs of the industry and agriculture.

The MRL has also set up a refinery engineering school of training, the first of its kind in India, on the lines of AMOCO's School of Engineering and Technology at Naperville, near Chicago.

Laying the foundation for an auditorium commemorating the 150th anniversary of the Madras Christian College Higher Secondary School here this evening, the Prime Minister called for a change in the present system of elitist schools for the privileged few designed during the colonial era and wanted good education to be made available for all. He pointed out that there were schools which lacked even basic facilities like blackboards. He said education should inculcate the spirit of dignity of labour which was lacking in Indian students.

Message from IAEA Chief

Madras THE HINDU in English 16 Dec 85 p 1

[Text] MADRAS, Dec. 15. In a message sent to THE HINDU for publication, Dr. Hans Blix, Director-General of the International Atomic Energy Agency, which has its headquarters in Vienna, commends the scientific and technological development being underlined at Kalpakkam today:

"The inauguration of the Indira Gandhi Centre for Atomic Research is a milestone in the development of nuclear science and technology. Its significance extends far beyond the frontiers of India alone: it is a truly remarkable achievement, and shows what can be accomplished by a developing country in the nuclear sphere when the determination and dedication is there. Nuclear power and nuclear science are not only for the rich countries.

"For a long time, India has had a very ambitious programme for nuclear development. Now with the commissioning of the Kalpakkam fast reactor, your country is taking another very significant step forward. This reactor has some features in common with plants in other countries, but in other respects it is unique--for example, in its use of a carbide fuel of Indian manufacture. Rather than waiting for others to develop fast reactors of a size and type which would lend themselves to deployment in Indian circumstances, Indian research workers have done the job themselves. The world scientific community will be keenly interested in reports of the experience acquired.

"On behalf of the International Atomic Energy Agency, I congratulate all concerned with this venture, wish you every success in the future, and assure you of our continued support.

Hans Blix"

It may be recalled that in his address to the IAEA's general conference in Vienna on September 22, Dr. Blix observed: "One should not forget...that uranium resources, like oil, are finite and I think we should note with appreciation that the world's experience of breeder technology--which could make uranium resources go very far--is further expanding this year, with Superphenix having gone critical and India inaugurating a new test breeder reactor near Madras."

Symposium

Heads of the nuclear establishments of over ten countries are to participate in a symposium on fast breeder reactors starting at Kalpakkam on Monday.

Among those attending the three-day symposium will be Dr. Hans Blix, and the Chairman of the Pakistan Atomic Energy Commission, Dr. Munir Ahmed Khan.

Three of the seven nations other than India, which have built or are building fast breeder reactors, have not sent delegates to Kalpakkam. They are the United States, the Soviet Union and Japan. France, Britain, West Germany and Italy will have delegates attending the symposium, which is to begin soon after the Prime Minister's visit to the Kalpakkam complex.

Interview with IAEA Director

Madras THE HINDU in English 16 Dec 85 pp 8, 9

[Text] The International Atomic Energy Agency (IAEA) which has its headquarters in Vienna is the keypoint body for international cooperation in the peaceful applications of nuclear energy within the context of the discriminatory non-proliferation regime. It is an intergovernmental organisation with well over a hundred members, and functions autonomously within the wider United Nations system.

By virtue of its mandate, the IAEA's work excludes anything connected with the non-peaceful, military side of nuclear energy. Its basic work is to foster and encourage, guide and advise on the development of the peaceful uses of atomic energy round the world. Functioning in a somewhat contentious field, it is a forum for the enactment of controversies and certain differences in outlook and experience.

Recently, N. Ram, interviewed for THE HINDU the IAEA's Swedish Director-General, Dr. Hans Blix, in Vienna. He is now visiting New Delhi for talks with the Prime Minister and other Government representatives and also Kalpakkam to participate in a symposium on fast breeders as a future source of power:

N. Ram: Dr. Blix, over the past four years during which you have led the IAEA, what are the principal gains for the international organisation? I refer particularly to the assessment put forward at the NPT Review Conference (Third Review Conference of the parties to the Non Proliferation Treaty held in Geneva in August 1985) that the IAEA is the principal agent for technological transfer in this field and there might be other activities as well where

gains came about. How would you sum up these principal gains and could you indicate some kind of perspective for the decade ahead?

Hans Blix: If you take first the developing countries, in these last four years the budget for technical assistance and the implementation of technical assistance programmes have gone up very fast. And this compares very well with other international organisations. We are giving increasing help on the question of using isotopes to find water. We are giving increasing help to the eradication of Medflies, increasing help to the use of nuclear medicine, more help also in the field of energy planning. In the nuclear power field, we have instituted new methods in advising governments on the safety of nuclear power reactors in the so-called Operational Safety Review Teams (OSART). We are also giving advice in radiation protection advisory teams, the so-called RAPAT missions. And we have set up the Incident Reporting System through which the experience on incidents and anomalies is exchanged. Now all this is an exchange of experience and, to some extent in many of the programmes, also a transfer of technology. So I think we have continued on the good path on which the Agency was under my predecessor, but we have expanded it. And we have maintained, and I would even submit increased, the efficiency of the Agency. Now this is the bread-and-butter activity, the down-to-earth activity.

Then, of course, the Chinese accession to the Agency is a very important event. And I think that the Soviet offer to submit some of their peaceful nuclear installations to (IAEA) safeguards is also a very important event. I know that in India and in many other countries they are saying that Agency safeguards inspection in nuclear weapon states does not reduce the number of nuclear bombs! Or doesn't bring any nuclear disarmament. And this is true. I am, however, of the view that the Agency is gaining experience on installations which we would otherwise not see; secondly, there is a feeling of a somewhat greater equity between the non-nuclear-weapon states submitting installations to safeguards and the nuclear weapon states.

And perhaps even more important, the experience we gain in inspection in nuclear weapon states is something that would one day be very useful in the context of disarmament. It is a precedent that nuclear weapon states accept verification. This is very important. Therefore I am happy that we are allowed to start this in the Soviet Union, and we have now also an invitation from China for talks...

Revocable agreements

The agreements we have with the four nuclear weapon states are not irrevocable. They have retained for themselves the right to move installations out of safeguards. It has not happened so far (as far as I know) but they have retained that right which, of course, makes it a different kind of thing from an installation that is submitted irrevocably to safeguards--under bilateral agreements or under NPT. But to me the particular value lies in the precedent. This, after all, is the world's first international verification system--that is a plant one has to care for tenderly.

Dual role

Q: With reference to the IAEA's well-known dual rule or two of its main roles--one which can be called 'promotional', the other related to safeguards, 'regulatory'. You have referred to it in various addresses: one is to promote the peaceful uses of nuclear energy, the other is to see that it is not used for military or destructive purposes. There has been a certain amount of criticism of the balancing of the two roles--reflecting not so much your own choice as the fact that the IAEA is bound to reflect a certain unequal global nuclear bargain. How do you see the situation today in relation to the strong support you have got in the main, and also in relation to the criticisms about the failure to balance these two roles?

Blix: Well, it's right that we often refer to the twin roles of the Agency--to promote the peaceful uses of nuclear energy, and to help in the efforts to impede the military uses. I think one must however keep in mind that these two reinforce each other. I think that safeguards are promotional of the use of nuclear energy. If you did not have safeguards, a number of things would not be sold. Nuclear trade would be enormously more difficult than it is today. So the fact that safeguards are there facilitates the expansion of the peaceful uses of nuclear energy. At the same time, the peaceful use of nuclear energy--nuclear power, for instance--reduces the shortage of energy, and energy is an important factor in many countries for peaceful development. If the pressure on oil resources were to increase (as it would if there weren't any nuclear energy), then the risks of friction would be even greater. So I think they reinforce each other. And I'm not quite accepting that they stand against each other.

Now the other point you ask about is: if you look at what are safeguards and what are other types of activities whereby we promote the use of nuclear power or other uses of nuclear energy ... well safeguards are up to some $30 millions a year in our budget; the technical assistance money is a little more than that. And also, in our regular programme, we have a fair amount of money that is devoted to developing countries directly. But all the rest is what you might say is promotional. Now some people say there should be balance--the same amount for technical assistance as for safeguards. My view is that there is hardly any limit to how much we could spend on technical assistance at least in the longer run; we cannot increase it drastically in the short run. For safeguards I don't think the Agency has a reason to ask for more than is needed to carry out the safeguards as a credible operation. I think we will need more than we have now, but there is certainly some limitation on how much we will need. On the promotional side, almost the sky is the limit!

Q: Regarding the application of safeguards, while there have been some controversies in the past about the scope of safeguards which is really a supplier-related problem ... while that may be, the safeguards have worked in that all your outstanding issues have been resolved in their application where they have been accepted. To what do you attribute this fact, because earlier, I think there were fears, certainly in the United States, that IAEA safeguards might not be 'adequate'. On the part of the developing countries also, there might have been some fears.

Blix: Well, essentially I see safeguards as a service to member states, to enable them to demonstrate with the maximum credibility that the installations which are submitted to safeguards operate in a peaceful manner. Therefore there should not really be any controversy or even friction between the country that has accepted the safeguards--whether over all its installations or over particular installations--and us, in the way it is to be carried out. Because there is the joint interest that this shall be credible. Now in practice, the world doesn't look quite as good as that. We do have our discussions with states about how much is needed, where are we to place cameras, can we develop the films in the country, can we not do that? So we do have a number of problems with this, but there is nothing that detracts from the efficacy of safeguards.

Divergent interests

Q: You emphasise the fact that the IAEA performs varied services for the member countries and this involves a certain attempt to harmonise divergent interests. Do you see them as terribly divergent or converging or ...

Blix: Well, the CAS (the IAEA's Committee on Assurances of Supply) is the forum where the interest of the consumers, the importing states, in having a reliable supply of fuel or technology or hardware is put up on the one hand; and the interest on the suppliers' side in continuous and credible safeguards, guarantees, on the other hand, is expressed. And that has made some progress. But there is still some way to go, so there is room for harmonisation. On the question of an international plutonium storage, there is also the interest of those who feel that increasing quantities of plutonium in the world are something to worry about and who would like to see not only the ordinary safeguards upon the plutonium but an additional seal, a declaration on the part of the country that if it takes out something from the plutonium stored, it would declare why it took it out and what it used it for. On this also, the governments within the Agency have not reached any agreement at the present time. So there remains room for harmonisation.

Safety, waste disposal

Q: Looking forward to the next decade, what are the major things that you would like to see solved so far as the IAEA is concerned?

Blix: Well, I am very keen on the small and medium sized power reactor question. I remain of the view that an expansion of the use of nuclear power in the world, including the industrially more advanced developing countries, is very important. We cannot, however, afford such an expansion without an absolutely maintained safety. Because any accident, whether in the United States or in developing countries, is going to hurt nuclear power everywhere. And therefore the introduction of nuclear power into developing countries will have to be done with a great deal of prudence. But I'm certainly in favour of it.

There are many developing countries that do not have other possible resources and I feel that India's example and India's efforts in this direction are

most impressive. And this also shows that a developing country can do it! Now India has an exceptional capacity in the scientific field and in the engineering field, but I think it could be emulated by other developing countries. We've seen how it works in Korea, in Taiwan and it can work in many other places. So this is an area where, with prudence, one ought to go forward.

The waste field is another one where I would hope for more international cooperation. I think we have been successful in the field of safety--both on the regulatory side, in drafting safety regulations etc, and in our actual services to member states. In the waste field we have done much less. It has not been a lack of ambition, but the fact is that governments, out of regard, I think, for public opinion, have not been very keen to consider the possibility of taking on the waste, or cooperation with other countries there. 'So we cater to our own problems, they are enough!' However, I think there would be many gains, economic and environmental, in greater cooperation and I see the Chinese offer, or opening to acceptance of foreign spent fuel or waste storage, as an interesting new departure. The Russians, of course, have taken spent fuel from Russian-made reactors for a long time and this, too, is some opening. I think there may be more of this in the future and the Agency should promote that.

Now these are two important areas. Food irradiation is a very interesting avenue and from the moment I came here, I've been enthusiastic about its exploration. That new method is now getting into gear and I think we are approaching the moment when it will be industrially used.

Q: There are a number of public fears in this respect...

Blix: Yes, but the fears in this field--as the fears in the nuclear power field--are terribly exaggerated. This is a technology that one can use prudently and rightly ... I think I myself would personally be more concerned about the widespread use of different chemicals in the food industry than I am about the irradiation of it. Now, lastly, reverting to the safeguards system, I think that a further consolidation of our safeguards operations and an expansion of these to make them give the maximum credibility are desirable. We have made great progress, but I would like to see these operations further consolidated.

Information dissemination

Q: Now there is another area that interests us particularly as journalists--the information sphere. You are now the single largest publisher of information on nuclear energy. Would you consider this efficient in terms of the investment, and is it being used properly?

Blix: Yes, as a publisher I think we are doing all right. As a distributor, I am not so sure. Those who participate in our symposia etc., get the records, and through the records a description of what came about in the discussions ... and a number of people in the scientific community certainly get them. But as for some of the publications which are a little more

popular, I doubt very much that the distribution reaches out far. There is room for considerable improvement here.

Q: In the latter half of the Seventies, there was much apprehension in Western countries--the U.S. Congress and so on, at that level--over the consequences of access to information by countries which had not acceded to the global nuclear bargain. But since then it appears these fears have subsided. Do you see any political problems involved in this in terms of access to science, technology and applications?

Blix: Well, I think with respect to applications in science and technology, what they don't want to reveal, they'll probably keep confidential! But, of course, we are the ones who are operating the International Nuclear Information System, the INIS. And that is a well-functioning operation, an enormously important thing. Everything is fed into these computers and any nuclear research institution around the world can just fire off a telegram or telephone call and they can get articles in a particular area coming over by teleprinters or by computers.

Buyer's market

Q: Now turning to another subject, you referred very clearly, both at the IAEA general conference and the NPT Review Conference, to the emergence of a buyer's market which was in notable contrast to the situation of, say, a decade ago. What are the implications? How did this happen, when did it happen, and is it a positive thing?

Blix: Well, the reasons, of course, are that the industrialised countries had anticipated a much quicker growth of electricity consumption than actually occurred. And therefore the dimension of the industry producing nuclear power reactors was larger than really was needed. It turned out to be so. They are therefore looking, all of them, to export markets--in particular to developing countries but also markets in Europe, say the Netherlands or Finland, which are now looking for power reactors. Now, it is good for the buyers that they can press the prices (down), because the sellers are very, very keen on the selling. So from their (the buyers') point of view, it is an advantage.

Q: And in the field of Small and Medium Sized Power Reactors (SMPRs) it has become...

Blix:...evident too. There is a strong interest on the part of the supplier countries in selling these.

Financing plans

Q: Then what holds back progress in the field of SMPRs?

Blix: Well, several things. For one thing, financing. It still is very difficult to dig up loans of the size that you are faced with here. A coal plant requires less money for the investment. It requires more money for

running and buying the coal, but the investment is less. Therefore, if you are very hard up, you may be inclined to buy something that is cheaper, but in the long run will be more expensive.

Q: And the World Bank might finance it, which in this case it does not?

Blix: The World Bank has not said, of late, that they would not be willing to contemplate financing nuclear (power plants). On the contrary, at a seminar recently here, they said they would look at these things...

Q: I see.

Blix: Now other constraints, of course, relate to the infrastructure and the manpower in the countries that may be interested in nuclear power. And that is an area where we can be helpful--in training and so forth--but it is not something that you change overnight. So those are also important constraints.

Nuclear independence

Q. If we may now turn to the Indian programme and certain policy features in India, what is your overall assessment? I'm also going to ask you about the possible implications of something you have discussed before--this 'expensive' nuclear independence. In the context of such perceptions, what is your impression about the Indian programme, including its problematical side?

Blix: Well, you can draw parallels to other energy sectors. Take the oil sector. There were many countries which imported oil and which did not bother to build refineries. In an oil crisis of the political kind, if they were cut off by countries possessing refineries, well, then they were badly off! They might have wished they had built refineries. However the risk of that occurring nowadays is perhaps not so great because there are more suppliers in the oil market than there used to be. There are also many more refineries. And therefore a country deciding for economic reasons that it is just as well to rely upon foreign suppliers may perhaps still be all right.

Now the nuclear is not very different, in my view. Today with uranium prices being what they are, the economic incentives to go reprocessing are not all that great. If uranium prices go up, then the incentive will be greater. And, of course, if you view very far ahead and realise that uranium resources are finite, well then you may wish to make use of the slumbering energy that you have in the spent fuel. For the time being, however, it would seem to me that the fact that you have more countries in the world which can provide enriched uranium offers a greater measure of safety for a country that does not itself go for enrichment. And the lesser interest in reprocessing, for economic reasons, has also led to a diminution in the interest in such technology.

Now a big country that is establishing a very big nuclear programme may feel differently about it. It may feel that it wants to have the complete fuel

cycle. Of enrichment, if it goes for enriched uranium, and of reprocessing. A country like Japan is evidently also going for a complete fuel cycle because it has no energy resources other than this. And for it, any stop in the provision of service from the outside would be regarded as a catastrophe. It is understandable that it would do the full (nuclear fuel) cycle. But many countries with smaller programmes will feel less concerned today about importation of enriched uranium and less concerned about not having reprocessing (facilities) themselves.

India and IAEA

Q: Are you happy with your interaction with the Indian nuclear programme and its policy postures? Or are there problems? For example, India (along with Argentina) doesn't participate in the IAEA's technical assistance programme as a recipient.

Blix: India takes part in a great deal of the exchange of experience and information that occurs in the Agency. India is also acting as host for quite a large number of Agency activities. There are no problems in this The Agency performs safeguards over some Indian installations--those which are submitted to safeguards. And we have no particular problems in that. As I said, the Agency's role is to perform a service in this regard. Other states may urge India to accept fullscope safeguards--safeguards over all its nuclear facilities. This is the foreign policy of many states. But the Agency is not taking a stand on this. If India says, 'yes, we would like to have safeguards on something', then the Agency is there to provide this service.

And it is clear that India is paying a price for not wishing to extend safeguards. But that is India's decision. The Agency as such is not having any discussion with India on these matters.

Q: On the question of a certain technological choice which is really related to the safeguards question ... we are functioning basically with the CANDU system and it has been developed indigenously and we are going into a 500 MW system soon. Is that the 'price' you are referring to, that you are basically restricted to one track or one technological option. And then fuel...

Blix: Yes. Any country that is not benefiting from, or for reasons it considers valid chooses not to make use of, the international market for the exchange of experience in a particular field ... if there is good technology available, it is a cost. It is not for me--it would be presumptuous of me--to discuss whether the cost is commensurate with the gain. Evidently you have decided in India that this is worth paying the price for. I can only, as a personal view, express admiration for the technological prowess and skill, the scientific skill that has been demonstrated in the Indian programme ... that will also be manifested in the inauguration of the test breeder in Madras.

Q: Yes, you referred to that in your statement to the IAEA general conference: it was in a very positive context.

Blix: Yes.

Q: The Superphenix and this (FBTR in Kalpakkam) were referred to.

Blix: Yes, I think it's our due to recognise the scientific and technological prowess that lies in this.

Food irradiation

Q: If I may briefly turn to another subject, food irradiation. Especially because India is a large agricultural producer and we have big losses in storage, problems with preservation and so on. Although we started the peaceful applications of nuclear energy very early--we were there almost at the start--official policy has not approved this use. And I believe that our Government is now favourably inclined to this, it is believed to be about to clear it. Do you have an overall assessment of this question? For a developing country it must be all the more important ... do you have a data base for food irradiation?

Blix: Yes. For years there has been experimentation. When I was in Bombay I saw the results ... how the irradiated tomatoes looked beautiful and how the non-irradiated looked rotten (laughter). Those were the first ones I saw; since then I have seen in many places how research is going on. And I think these experimental data are sufficient to demonstrate the validity and the wholesomeness of this procedure. And indeed the codes adopted by the FAO (Food and Agriculture Organisation) and the WHO (World Health Organisation) have given their approval of it. So I have no doubts in that. Now you have this as a start. On the other hand, you have the enormous losses in food that occur everywhere, but in particular in the developing countries which would need food the most.

The question is how do you apply this new experience that indicates a safe method of preserving food to the situation of developing countries? Well, that's the implementation on an industrial scale ... and that is a big difficulty. I think it will come, but it is not easy. The only place I have seen this was early this year in (a facility in) Japan, where they were irradiating, about 15,000 tonnes of potatoes each year. The potatoes of the past year could be used in the new year. And that kept the prices down because otherwise you get sprouting. I understand that in the Netherlands too they have done it on a fairly large scale. South Africa, I understand, has also succeeded in irradiation of foods of various kinds.

I think it is coming on a l[illegible]cale. But when you have a developing country with villages that are fairly backward, one should not be too optimistic that you're going to save the grain in the village silo or something like that. I think it is more likely that at fixed points in huge cities, where food is brought in, maybe one could have irradiation to protect oneself against salmonella and lots of other things. Or at export points or import points. But here are very significant organisational and industrial problems to solve. We are not there yet, it will take a number of years, but I see a dynamic development in this field, yes.

Pakistan's nuclear venture

Q: Thank you. Just a couple of other questions. How do you see Pakistan's nuclear programme? I ask because of the high level of political concern in our region--both in India and Pakistan--of the interaction between the two programmes. And certainly in Indian official statements and in the media, we have a certain perception of a very risky process. Pakistan is seen to have a clandestine programme along with its safeguarded or open side. Do you have any information which is relevant to this?

Blix: No. As in the case of India, our work is to perform a service, namely to safeguard the installations that are submitted to us. We are not meddling, we are not an international espionage organisation to find out what a state is doing in areas not safeguarded. We have the technical function of running these safeguards in an efficient manner and we have no problems in performing the safeguards in Pakistan today ... what is submitted to our safeguards. Of course, with safeguards having the purpose of creating confidence, any installations which are not submitted to safeguards may well be peaceful but they do not have that extra evidence of peacefulness which comes from the safeguards verification. That applies both in Pakistan and India, but we have no knowledge about these installations and therefore we do not talk about this.

Impact of discrimination

Q: Finally, on the Third NPT Review Conference. Two types of views have been heard on the IAEA's role in this. On the one hand, the United States and the Soviet Union also took the position, that the IAEA was very much involved in it ... you have a responsibility to perform in relation to the NPT or global nuclear bargain. On the other hand, you had criticisms such as the one put forward by Dr. Raja Ramanna (Chairman of India's Atomic Energy Commission and leader of the Indian delegation to the IAEA's recent general conference) that neither the IAEA nor India, for example, is in anyway bound by the NPT, the decisions, the proceedings of the NPT review conferences. It seems to me that this is an uneasy relationship. You are there and yet the conflicts have an obvious impact on you. And since it is a very unequal thing as we see it--there's a discriminatory element--the IAEA also suffers from the impact of this. What is your view of these issues?

Blix: Well, the NPT requires of its members that they shall submit all their nuclear installations to safeguards. And the Board of Governors of this organisation (the IAEA) has adopted a model for these safeguards and we administer them and we conclude safeguards agreements with the NPT states. In response then to the clause about safeguards in the NPT ... that gives us business, it gives us work, in the same way as the Tlatelolco Treaty (the Treaty for the Prohibition of Nuclear Weapons in Latin America, signed in 1967) which I think you do not consider an unequal one--also specifies that its members shall submit all their nuclear installations to safeguards, and conclude agreements with us about safeguards. So in this sense, it is bound to be of interest within this organisation what the parties to the NPT want to do in the future.

But we are not the Secretariat of the NPT! That we are not, nor are we the Secretariat of the Tlatelolco Treaty. And therefore we do not have any reason to look at a number of the conclusions which the conference drew ... their conclusions which relate to the Agency, recommendations or otherwise, should be looked at here. But the (Review) Conference of the NPT does not decide anything for the Agency. It's our own policy-making organs that do that.

THE HINDU: Thank you, Dr. Blix.

Correspondent Notes Significance

New Delhi PATRIOT in English 16 Dec 85 p 5

[Text] Although Pakistan President Gen Zia-ul-Haq will, for reasons best known to him, not be present at Kalpakkam on 16 December, a top Pakistani scientist, Dr Munir Ahmed, will be there to witness India's first fast breeder reactor in operation. Leading scientists and nuclear specialists from France, the Soviet Union and other major industrial powers will also join the occasion. A Chinese nuclear scientist is expected at Kalpakkam too when Prime Minister Rajiv Gandhi dedicates the FBTR and MAPS-II to the nation.

December 16, 1985 is a day of great significance in this country's quest to harness the power of the atom: and not only because India can now be counted along with the top six nuclear nations of the world--all of them advanced industrial powers--for having commissioned a fast breeder test reactor with its own capability.

The occasion marks a triple thrust for India. The country is launched on the road to abundant and commercially viable nuclear power generation; there is a breakthrough of a special import for India in the realm of fast breeders; and, not the least significant, this country has been placed on the threshold of higher echelons of science and futuristic technologies.

What is the place of MAPS-II in this nuclear scenario? MAPS-II demonstrates clearly that the nuclear power programme of this country is reaching a stage of maturity. MAPS-I was a test case for India's nuclear scientists and engineers--a test of capability to design, construct, manufacture, commission and operate a nuclear power plant entirely by themselves. They have emerged from this test with flying colours, and the operations of MAPS-I, commissioned in July 1983, made India the first developing country of the world with such a capability. The commissioning of the second unit of the Madras Atomic Power Station has consolidated this achievement. Moreover, it advanced nuclear self-reliance a step further with a display of dynamism in this field of advanced technology. MAPS-II, it could aptly be said, gives the green signal for a sound launching of the programme for achieving 10,000 MWe of nuclear power generation by the year 2000.

The urgency of developing the country's electric power generation reinforces in the importance of MAPS-II, for the project also shows that Indian

technology in this sphere is vibrant and developing. And, the back-up industrial support for its application and rapid project construction is being built up with meticulous care and dedication. Between RAPS-I and II and the reactors at MAPS, there has been no stagnation but constant technological advance. Each unit incorporates improvements over the other. For example, the end shields in MAPS-II are better in terms of materials used and the quality of construction. The levels of radiation in different areas of MAPS-I and II have been generally low in comparison with the Canadian-designed RAPS units, due to improvements in design and the quality control of components. The same applies to other functions and operations in the nuclear units that have come up, such as recovery of precious heavy water and the technology for upgrading the heavy water recovered from plants--specially important for RAPS.

Two other facets deserve to be noted: the capacity for quick absorption and application of higher technologies--foreign and self-developed--by India's nuclear establishment, and secondly, rapid rate of indigenisation. As for indigenisation and the capability to fabricate the main components inside the country, the level reached by MAPS-II is almost 90 per cent--a constant ascent from RAPS-I onwards. What now remains for import is only special materials and inputs and a few components. And as for the first facet, the most significant is the depth and the breadth of expertise attained by India's nuclear specialists, both scientists and engineers. Three generations of expertise have been added since the days of Homi Bhabha, the titan who laid the foundation of India's nuclear programme. This is shown in a striking way by the fact that at the time of initial criticality of MAPS-II, most of the start-up operations were in the hands of young nuclear technologists in their twenties and thirties.

The breakthrough achieved in the sphere of fast breeders marks the commencement of a second, and a higher phase of India's nuclear power strategy, opening a new long-term vista in the decades ahead. The FBTR went critical on 18 October, and its operations in these two months have been almost flawless--an event of world-wide import, giving unbounded self-confidence to India's nuclear specialists.

One of the biggest challenges to Indian scientists posed by the FBTR was creation and development of the fuel required by liquid metal-cooled fast breeders. The mixed carbide fuel, based on enriched plutonium 239 and natural uranium, prepared by Indian scientists is the first of its kind in the world. Hitherto, western countries have been using mixed oxide fuel based on enriched uranium. Besides replacing enriched uranium by plutonium, the Indian scientists found the carbide fuel to be better and more compatible with the sodium coolant used in the Indian fast breeder. According to Indian scientists, the mixed carbide fuel they have devised has several advantages over the uranium rich mixed oxide fuel. Among others, it has 5 to 7 times better thermal conductivity, 30 per cent higher heavy atom density, and above all, excellent compatibility with the sodium coolant as compared to the oxide fuel.

The FBTR has a great significance in India's nuclear plans as well as in the economies related to power generation. For, fast breeders not only generate

power but do much more--continuously create or breed far more nuclear fuel than they consume. The FBTR itself will, in a few years, breed enough fuel not only to recharge itself, but also to provide a start-up charge for another full size fast breeder reactor.

The successful operations of the FBTR after attaining criticality on 18 October have paved the way for the next full-size 500 MW fast breeder reactor, a prototype of fast breeders of the next decades, work on which has already commenced at the Reactor Research Centre (RRC). The blue-print of design of this fast breeder is ready and construction activity on it will be undertaken shortly, using fully the experience of the FBTR's operations. Plutonium 239 for fuel of the initial charge of fast breeders will be available in sufficient quantity by reprocessing spent fuel from the chain of indigenously built pressurised heavy water nuclear reactors already commissioned or under construction. Thereafter, the fast breeders will be self-sustaining.

Together with BARC, the Reactor Research Centre comprises a base of higher research and development in the nuclear field and allied disciplines. The two work in unison and in that lies their exceptionally high capability over the entire range of study, research and application. Together with RRC, the BARC has developed the fuel for the FBTR, while RRC facilities and scientists have contributed to the BARC in launching DHRUVA, the world's largest research reactor, in August 1985, completely designed and built by scientists and engineers of these to institutions. When DHRUVA becomes fully operational, BARC will become one of the most extensive research reactor complexes in the world.

A third institution of higher science and research is now being set up in the country--the Centre for Advanced Technology--at Indore, largely as an out-growth of scientific manpower and attainments of BARC and RRC. The three institutions, it may be said, will be a trinity, taking Indian science and technology to still higher levels. The Centre's major thrust will be in the areas of lasers, accelerators and fusion related research and technology development. The Centre will not complement BARC and RRC, but create new lines of development of relevance to defence, electronics, computer aided developments in the higher technologies and for creating alternative sources of energy.

Comment by AEC Chairman

Madras THE HINDU in English 16 Dec 85 p 17

[Article by Dr Raja Ramanna: "Proven Viability of Nuclear Power"]

[Text] The dedication to the nation by the Prime Minister of the reactors at Kalpakkam, the Madras Atomic Power Station and the Fast Breeder Test Reactor, is a red letter day in the development of atomic energy in India. On the same day Mr. Rajiv Gandhi will rename the Reactor Research Centre as 'Indira Gandhi Centre for Atomic Research' in a fitting tribute to the previous Prime Minister. No document on the history of India in recent times

can omit Mrs. Gandhi's name if it deals with the development of science and technology in the sub-continent. Mrs. Gandhi was fully aware of the power of science and the usefulness of atomic energy in the development of India's economic strength. She was even fully conversant with the many aspects of the complicated technological inputs that go to produce atomic power. It is, therefore, a pleasure for all scientists and engineers in the Department of Atomic Energy to express their gratitude to her by suggesting to the present Prime Minister that the Reactor Research Centre be named after her.

It has already been brought to the attention of the public that the development of the Fast Breeder Test Reactor ushers in the second phase of the atomic energy programme in the country. It has been the dream of all Indian planners to use seemingly useless and unwanted material for the production of power. The development of the new carbide fuel for the Fast Breeder Test Reactor, which promises a higher breeding ratio, brings closer the possibility of using the country's vast thorium resources. This entirely new development, specifically solved for Indian conditions, is significant for energy planners in the country for the next century. It is not that all the problems have been solved or that the economics have been fully established in the utilisation of thorium, but India has taken an important step towards the utilisation of this plentifully available raw material. This is a matter of great significance.

The dedication of the Madras Atomic Power Station by the Prime Minister also brings to memory the occasion when Mrs. Indira Gandhi formally inaugurated Unit-I of the station on July 23, 1983. Unit-I was the first power reactor to be entirely fabricated in India and naturally had certain teething problems. On the occasion of this dedication, the Indian public would be happy to know that Unit-I has worked exceedingly well with a high capacity factor and that Unit-II has begun to work satisfactorily from the very first day it was switched on.

It is also interesting to note that in November 1985 when the Tamil Nadu coast was being lashed by one of its most severe storms, power was flowing to the grid from the MAPS without interruption. This is indeed of tremendous significance in that it imparts great confidence to the people who have designed and built it, about the stability of such reactor systems.

The coming to criticality in recent months of 'Dhruva' at Trombay, the Fast Breeder Test Reactor and Madras Atomic Power Station Unit-II at Kalpakkam sweeps away several doubts about India's capacity to use nuclear energy for peaceful purposes. The research teams are of high quality and the engineers who designed and constructed the reactors are now fully trained to rise to all occasions especially now that a new indigenous technology has been introduced.

It is, of course, a pity that there are still people who use wrong or old information to insist that nuclear power is of no significance to this country. It is also sad that they will not even listen to technical explanations. On their part, the nuclear scientists are trying their best

to explain to all concerned the benefits of atomic energy and the elaborate controls that are exercised to keep it safe. To date there has not been a single radiation induced fatality in the whole world due to utilisation of atomic energy for power generation.

India missed the first industrial revolution 200 years ago. Now it is moving with full momentum towards the second industrial revolution, and people must be well informed so that the Indian people do not miss it by wrong assumptions and are not misled by vested interests. The nuclear technologists have to be constantly on the watch that nothing is done to withhold developments for the future.

It is, therefore, a day of rejoicing that with the support of Jawaharlal Nehru, Indira Gandhi and the present Minister for Atomic Energy, Mr. Rajiv Gandhi, the country has been able to chalk out its programme to establish 10,000 MWe of nuclear power by the end of the century. This figure is small compared to what other countries are doing such as the United States (1,07,109 MWe), France (53,328 MWe), Soviet Union (1,01,612 MWe), and Japan (37,648 MWe) but that India is putting it up in spite of many constraints shows the viability of its development after independence. From a country which could not produce quality nuts and bolts it has become one which can produce the most sophisticated of items, such as those required for liquid metal cooled fast breeder reactors.

It is my pleasure to express my admiration for all those who took part in the construction of the Fast Breeder Test Reactor, especially the former Director, Mr. N. Srinivasan and the present Director, Mr. C. V. Sundaram.

New Directions of Research

Madras THE HINDU in English 16 Dec 85 pp 18, 22

[Article by C. V. Sundaram: "New Directions of Research on Fast Breeders"]

[Text] The commissioning of the Fast Breeder Test Reactor (FBTR) on October 18, 1985 marks the beginning of the second stage of India's three stage programme for nuclear energy. The FBTR is a sodium-cooled, plutonium-fuelled loop type reactor designed to produce 40 MW of thermal power and 13 MW of electrical power. Power generation, however, was not the main goal in building the FBTR. It is essentially an experimental reactor for testing fuels and materials for use in larger power reactors. The scientists have also gained valuable experience in reactor design, indigenous manufacture of components, sodium technology and fuel development in the process of constructing the FBTR.

A very important aspect of the FBTR project is that the construction of the reactor was essentially an indigenous effort. A bold decision was made to fabricate all the major components like the reactor vessel, fuel and reflector subassemblies, rotating plugs, control and drive mechanisms, sodium pumps, intermediate heat exchangers, steam generators, the special steam turbine, sodium piping, fueling machines, central data processing

extract ten to fifteen times more energy per unit mass of fuel than that extracted in thermal reactors. The high fuel burn up combined with a hostile environment of intense fast neutron flux, elevated temperatures, steep temperature gradients and liquid sodium cause interesting and challenging materials problems for in-core LMFBR components.

Important data that have to be generated through irradiation testing in the FBTR pertain to swelling rates, creep rates, and evaluation of thermo-mechanical properties of candidate fuel and structural materials under fast neutron irradiation at high temperatures and high flux levels. In addition, studies will be made to understand the physical and chemical behaviour of the fuel and clad at high burn ups involving phenomena such as fuel cracking, fission gas release, plutonium and fission products redistribution, clad corrosion, fuel-clad mechanical interaction, and the effects of porosity and stoichiometry.

The fast neutron exposure obtained over the life of a commercial fast reactor fuel element is relatively high, and simulation of such exposure can be obtained only by irradiation of test samples for a period of over three years in the FBTR. The development of special subassemblies for inpile irradiation testing and measurements, the efficient execution of well planned irradiation experiments and the analysis of the obtained results will be the objectives of a purposeful and active research programme with the FBTR in the coming years.

Towards prototype FBR

With the successful commissioning and achievement of first criticality of the FBTR, the first phase of the breeder reactor programme at this Centre has reached a culmination, and a beginning has rightly been made on the design of a Prototype Fast Breeder Reactor (PFBR) with a capacity of 500 MWe. The setting up of such a commercial sized reactor by the year 2000 with full participation of Indian industry will provide the impetus for a series of such reactors to be built in the early decades of the next century.

The capacity of the PFBR has been arrived at after a careful consideration of steam turbine availability, grid capability, costs, the present status and future requirements of the breeder programme etc. The PFBR will be a 'pool' type LMFBR, unlike the FBTR which is a 'loop' type. In the pool design, the primary pumps and the intermediate heat exchangers (IHXs) are located inside the reactor vessel thereby eliminating the primary piping. It is planned to have four heat transport circuits, involving four primary pumps, eight IHXs, four secondary loops with pumps and 12 steam generator modules. The chain reaction will be controlled by 12 control rods.

There are many fascinating aspects and challenging tasks in the development of technology for a PFBR. The main technological challenge stems from the very large size of reactor components and different design features of some components when compared to those of an FBTR. The concept of the primary circuit housed in the main sodium tank, preferred on account of its inherent

system, control room panels etc., within the country. The sodium handling and purification techniques for the FBTR have been developed entirely at the Research Reactor Centre.

The FBTR uses, for the first time in the world, a mixed carbide of uranium and plutonium as fuel for driving the reactor. This fuel was indigenously developed and manufactured at the Bhabha Atomic Research Centre.

Supporting R & D

For the success of any high technology venture, research and development support is crucial. Therefore, several laboratories were established in the Kalpakkam Centre to provide R & D support to the FBTR project and for the future development of fast breeder technology. Thus today there are well established laboratories dealing with reactor engineering, radiometallurgy, radiochemistry, fuel reprocessing, materials development, materials science, electronics and instrumentation and safety research.

Further, a design group which has considerable experience in nuclear steam supply system, reactor physics, sodium system and instrumentation has grown to maturity, ready to take up the challenge of the next phase of the nuclear power programme. Multi-disciplinary research involving all these groups is necessary for designing and constructing a larger fast breeder reactor that will provide power to the nation in a safe, reliable and economical manner.

The R & D groups have already contributed to the successful completion of the FBTR project. The design and fabrication of the fuel, selection and evaluation of structural materials, sodium purification and handling and testing of reactor components in sodium are examples of R & D support.

Utilisation of test reactor

The FBTR is at present being operated at low power in order to measure the reactor physics characteristics of the core which uses a new carbide fuel. The reactor physics measurements being made and also to be made later are expected to yield a wealth of information which would be used to develop the capability for fast reactor design studies in India.

The operation of the reactor also leads to an understanding of the behaviour of various sodium components, the transport of radioactive nuclides in the primary circuit, the dynamic behaviour of the plant as a whole, the behaviour of the failed fuel detection system and other instrumentations. The operation of the FBTR in conjunction with specific engineering experiments will lead to important information to be used for the establishment of a reliable design for future larger LMFBRs.

The operation of FBTR as an irradiation test bed assumes special significance in the context of the need to develop an advanced fast reactor fuel for effective breeding and rapid exploitation of India's nuclear resources. On account of the economics of the fast reactor fuel cycle it is necessary to

safety, also requires studies of flow distribution within the main tank and component arrangements. While in the case of the FBTR, the design and manufacturing know-how were made available through a technical collaboration with the French Atomic Energy Commission and French industries, the emphasis now is to develop the large systems of the PFBR on our own, considering the confidence gained in the course of construction/commissioning of the FBTR.

Engineering development is thus necessary to finalise the design and to verify the performance of components in simulated reactor conditions over sizable periods of time. The latter requirement will call for manufacture and testing of the prototypes of critical components in sodium test facilities. The following describes the main areas of engineering development needed for the fast reactor programme.

Pool and component hydraulics: In the so called "pool concept" where the complete primary circuit is housed in the main sodium tank, "cold" sodium at 380°C contained in the outer region of the tank is circulated through the reactor core by means of submerged pumps. The hot sodium flows from the core at 530°C into the heat exchangers (also submerged in the sodium tank) where it gives away its heat to secondary sodium and discharges back into the pool. An inner vessel separates hot and cold sodium in the main tank. This arrangement requires a detailed experimental study of coolant flow distribution in the normal and off normal conditions of the plant.

Further it is important to ensure freedom from gas entrainment in sodium from its free liquid surface, and absence of vibrations of various submerged parts. All these studies can be carried out in water which simulates sodium pretty well, thanks to its comparable free flowing property and density. Other hydraulic studies based on similarity of fluid properties between water and sodium include flow distribution, measurement of fluid pressure losses and tube vibrations in the intermediate heat exchanger, steam generator, and fuel assemblies and study of model and full scale sodium pump.

Experimental stress analysis: Though the design of certain crucial components of reactor assembly such as inner vessel, grid plate supporting the fuel core and roof structure can be carried out following guidelines from established engineering codes, their service conditions, particularly high operating temperature, and their geometrics are such that it would be prudent to back up the design with experimental measurement of strains on scaled down models.

Component manufacture and testing: As the large mechanical components for the PFBR will be constructed for the first time in the country, difficulties and surprises during manufacture should be anticipated. However, to minimise these, it is planned to manufacture one prototype each of the critical components such as steam generator, control rod drive mechanism, sodium pump etc. followed by their testing in simulated reactor environment. Sodium test facilities are being planned to cater to sodium testing of components where simulation in water/air is not adequate.

Development work on sodium pump and steam generator have been already initiated.

Fabrication: Very large size nuclear components will have to be fabricated indigenously for the PFBR. For example, the reactor vessel, to be made of reactor grade austenitic steel, will have 15 m diameter, 13 m height, 20 mm thick cylindrical shell and 35 mm torispherical bottom. Fabrication technology will have to be developed and optimised to achieve the required tolerances and quality. Very high quality weld joints have to be made for various mechanical components. The development efforts will have to include mock up testing to assess the welding distortions. For some critical components, full scale mock up fabrication will have to be made. The precision machining and welding and fabrication to close tolerances of such large, complex geometry nuclear components will be undertaken for the first time in India.

Fuel development

A mixed oxide of uranium and plutonium containing 15-30 per cent plutonium is generally used as fuel in the current generation of fast breeder reactors. However, mixed carbides and nitrides are potentially superior because of their better physical properties such as thermal conductivity and density. A higher thermal conductivity makes it possible to extract more heat from a given length of a fuel column. A higher density of heavy metal atoms can lead to better breeding ratios. For the FBTR, a mixed carbide of uranium and plutonium was chosen as the fuel not only because of our interest in this potentially superior material but also because of better compatibility with clad and coolant when the plutonium content is high as required for a small fast reactor like the FBTR.

The FBTR fuel has, however, been designed on the basis of limited information available on the properties of a mixed carbide with high plutonium concentration. Often the scientists had to resort to theoretical analysis in the absence of experimental information. The post-irradiation studies on this fuel after it is burnt in the reactor will give the necessary data to improve its performance so that a burn-up of 5 atom per cent is realised.

A commercial fast breeder reactor can generate power at competitive prices only if the maximum possible energy is extracted from its fuel bundles. Thus the development of a reliable, high performance fuel is an important task in the programme to construct the PFBR. The fuel must be capable of high burn-up (greater than 10 atom per cent), and high breeding ratio. Initially, the fuel is designed on the basis of predicted physical and chemical properties of the burnt fuel which contains a host of fission products in various chemical and thermodynamic states. Some of these predictions can be validated through simulation experiments outside the reactor. Irradiation experiments followed by post irradiation studies in hot cells are necessary to arrive at an optimum design.

Such a fuel development task calls for multi-disciplinary research involving metallurgists, chemists, physicists and chemical engineers. If we continue

in our efforts to develop the mixed carbide and, perhaps, mixed nitride fuel, we will be pioneers in the field of advanced LMFBR fuel development. Looking further into the future we also have a strong interest in developing thorium based fuels and this also is an exciting advanced area of work.

Hot cells fitted with very sophisticated equipment and provided with inert atmosphere for studying irradiated carbide fuel have already been set up.

Sodium chemistry & technology

Liquid sodium, used as the coolant in the fast breeder reactors, is compatible when in the pure state with the stainless steel structural materials. However, impurities such as oxygen and carbon, even at parts per million levels, can cause corrosion and mass transport. There is considerable incentive in minimising the corrosion allowance provided in the design of structural materials. For this, one must understand the mechanisms of these processes and also monitor impurities in reactor loops. Developing techniques for these is part of the on-going programme. Understanding activity transport in reactor loops and mitigating its effects in the maintenance of reactor components is another area which deserves attention. Leaks in the steam generators which can lead to sodium-water reactions can be detected quite easily using sensitive detectors under development.

The PFBR is much larger in size compared to the FBTR and, therefore, developments in sodium technology must take this into account. For example, the sodium inventory in the PFBR will be about 3,000 tonnes as against 90 tonnes in the FBTR. To keep this sodium pure, 'cold traps' with increased impurity trapping capacity have to be developed. To provide the high sodium flow required through the core, much bigger sodium pumps (6000 m3/hr capacity) have to be designed, manufactured and tested. For pumping sodium in smaller loops and for measuring its flow, electromagnetic pumps and flow meters are required. Sodium being opaque does not permit the direct viewing of components immersed in it. Hence under-sodium viewing instruments will be developed for in-service inspection of components. A system based on pulse-echo technique is currently undergoing trials. The detection of the onset of boiling in overheated coolant channels is important from the point of view of safe operation of the reactor. Systems based on acoustic noise analysis technique are also under development for this purpose.

Fuel reprocessing

The fuel cycle is closed through fuel reprocessing which separates and purifies the plutonium produced in the fast breeder reactor for refabrication into fuel assemblies. Thus reprocessing occupies a crucial position in the fuel cycle as its efficiency is vital to both the system doubling time and fuel cycle cost. The reprocessing programme will undertake reprocessing of mixed carbide fuel irradiated in the reactor on an experimental basis which will in addition to recycling of plutonium to the reactor enable (1) qualification of equipment developed for radioactive operation (2) improved understanding of process chemistry related to the dissolution of plutonium

rich carbide fuel, the solvent extraction of plutonium from plutonium rich nitric acid solution in presence of uranium, the fission products and to the radiolytic degradation of solvent, (3) gaining experience in handling materials high in alpha, beta and gamma radiations.

Reprocessing of fuel discharged from a 500 MW prototype fast power reactor involves scale up of operation, that is several folds larger in magnitude compared to the test reactor. The reprocessing programme will, therefore, focus its attention on engineering and system studies related to scale up of equipment and on design concepts that are essential for an economically viable safe industrial plant. This involves engineering studies related to: (1) development of continuous equipment almost in every unit operation to meet high capacity and critically safe geometry (2) remotely operated equipment for various operations and (3) on-line instruments.

A hot facility is being built as a part of the Kalpakkam Fuel Reprocessing Plant which will be operational during the next decade. This plant will also treat on an experimental basis fuel discharged from the prototype fast reactor as a prelude to large scale establishment of fuel reprocessing of FBR fuels.

Welding constitutes the most important fabrication procedure in the construction of fast reactors. The materials development activities for welding consumables are also therefore required. A systematic study of the effects of the welding process variables, choice of electrode/filler, pre and post-weld heat treatments on the macro and microstructures, mechanical properties and corrosion behaviour of weldments of both austenitic stainless steels and ferrite steels of interest have already been initiated.

It is known that the service environment can have considerable influence on the life of the reactor components particularly with respect to creep, fatigue and creep-fatigue interaction effects on component life. Hence facilities for creep, fatigue and corrosion testing of samples in flowing high temperature sodium of controlled purity are being planned.

Materials science studies

Radiation damage is one of the serious problems facing fast reactor structural materials. Recognising the fact that the damage arises essentially due to defects, the Materials Science Laboratory lays emphasis on the basic study of defects. Most of its research revolves around the characterisation, growth, kinetics and dynamics of defects and their effects on the various materials properties.

A survey of the areas of R&D in LMFBR technology being pursued at the Indira Gandhi Centre for Atomic Research has been presented above. The research and development activities have far reaching implications and are relevant to the emerging energy systems technologies of the 21st Century.

During the crucial formative years, the R&D programmes of the Centre have been guided by a Planning and Coordination Committee with Dr. R. Ramanna as

the Chairman and Mr. N. Srinivasan as the Project Director. Special mention should also be made of the individual contributions of Mr. N. L. Char (Projects and Engineering Services), Mr. S. R. Paranjpe (Reactor Engineering and Design), Dr. G. Venkataraman (Physics, Instrumentation and Electronics), Dr. P. Rodriguez (Metallurgy), Dr. C. K. Mathews (Radiochemistry), Mr. G. R. Balasubramanian (Fuel Reprocessing) and Dr. D. V. Gopinath (Safety Research), and their colleagues.

Indigenous Components by BHEL

Madras THE HINDU in English 16 Dec 85 p 21

[Article by C. N. Garg]

[Text] The Hyderabad unit of Bharat Heavy Electricals Limited, situated at Ramachandrapuram, forms a vital link in the BHEL complex. Started with the manufacture of 12 MW and 60 MW turbosets for thermal power plants in 1963, BHEL, Hyderabad, soon diversified its activities by absorbing the latest technologies from world leaders to meet the new challenges and changing needs of the country.

With continuous efforts towards modernising its technology and taking up a new range of products, BHEL, Hyderabad, readily accepted the challenging task of manufacturing the block pile components for the Fast Breeder Test Reactor at Kalpakkam.

For the first time in the country, important components of a Breeder Test Reactor block pile, namely, reactor vessel with double envelope (RV with DE), large rotating plug (LRP), small rotating plug (SRP), thermal shields (TS), vessel and plug support (VPS) and liquid metal seals (LMS), have been manufactured at Hyderabad. The factory erection test of the reactor vessel, thermal shields, neutron shields and parts of grid plate was the special feature before despatch of the components to Kalpakkam. Due to the high operating temperatures and fast neutron exposures, the manufacturing specifications for the components are more stringent than the ASME Sec. III usually followed for thermal reactor components. They were successfully manufactured by BHEL under the guidance and strict surveillance of engineers from the Reactor Research Centre and third party inspectors.

Since sodium is involved as coolant and the materials are exposed to high neutron environment, special stainless steel of Gr. AISI 316 (17% Cr, 13% Ni & 2% Mo) was prescribed in the manufacture of these components. Together with high degree of skill in forming the materials to shape, it was also necessary to adopt special welding techniques in welding the components. High elongation values of 40 per cent were achieved on the welded specimens taken in the procedure qualifications and test coupons.

Also, since accurate alignments of the large rotating plug and small rotating plug are to be done over 700 odd positions on the grid plate for loading and unloading core sub-assemblies, special machining operations to achieve verticality, horizontality and eccentricity have been carried out on large

machines like SK 125, W 250 and SR 3150. The large rotating plug and small rotating plug have been stacked with boronated graphite bricks and steel plates to serve as thermal and biological shielding. The dimensions of the large rotating plug are 3.4 metres dia, 2.5 metres height and about 40 tonnes weight. The tolerance on radius of the formed 10 mm shell was only 1.5 mm and this has been achieved. The most critical component of the reactor is the reactor vessel with a maximum dia of 3.2 metres, length of 8.5 metres and weight of 15 tonnes, the concentricity between the top and bottom flanges was to be within 1 mm and parallelism within 0.1 mm per one metre length. To achieve these values, accuracy was maintained on individual shells and sub-assemblies with strict stage inspections using dial indicators and optical alignment tools and the only accurate finish machining of the entire assembly was carried out. Important large dimensions were computed at 20°C to take care of changes due to temperature variations.

The assembly of the reactor vessel and other block pile components had to be done in clean conditions. At Hyderabad, a nuclear clean hall was specially erected. A passivation hall was also erected for chemical cleaning and passivating the components before being taken to the nuclear clean hall for further assembly.

At Hyderabad, a group of dedicated and committed engineers, technicians and artisans who fully understood the quality requirement of the programme was assigned this work.

The Director of the Reactor Research Centre, Kalpakkam, was satisfied with the quality of work done by BHEL. He remarked that "the industry rose to the occasion to fabricate components to unusually high standards."

Capability of BHEL

Madras THE HINDU in English 16 Dec 85 p 23

[Article by E. S. Chandrasekaran: "Capability To Meet Exacting Demands of Nuclear Components"]

[Text] The Madras Atomic Power Station at Kalpakkam is being dedicated to the nation today by the Prime Minister. The occasion also marks the rechristening of the Reactor Research Centre, as "Indira Gandhi Centre for Nuclear Research. India today is on the threshold of important achievements in nuclear power development. The long range plans of the Department of Atomic Energy (DAE) call for installation of 10,000 MWe nuclear power generating capacity by 2000 AD. The achievement of this objective calls for well-coordinated national efforts of a very high calibre and Bharat Heavy Electricals Limited is proud to be a partner in this great endeavour.

BHEL, Tiruchi, has been actively involved in the power and research programmes of the DAE for the last 15 years. It all started with the development of technology and manufacture of prototype channel covers and heavy water headers. This developmental work proved a success and BHEL, Tiruchi, was entrusted with the fabrication of bigger and sophisticated

nuclear components which call for very high levels of dimensional accuracy and quality.

Equipment for MAPP

The first major order executed by BHEL, Tiruchi, was for the supply of reactor headers and steam generators for MAPP. The reactor headers (there are four of them in a 235 MWe unit) form the main interlink of the heavy water coolant circuit of the reactor. The dimensional accuracy, weld quality and non-destructive test requirements called for considerable developmental efforts and a prototype header had to be manufactured to prove the technology. The reactor headers have now become a part of BHEL, Tiruchi's regular product range.

Subsequently, it took up technology development for the manufacture of nuclear steam generators. BHEL developed the required skill and facilities and manufactured the steam generators for the MAPP-2 unit. There are eight steam generators in the unit. Heat produced in the reactor is carried by the heavy water to the steam generator. There, it is utilised to produce steam. Each steam generator consists of a steam drum, eleven U-tube heat exchangers, heavy water inlet and outlet headers for the heat exchangers and feed water header. Each heat exchanger contains 195 U-tubes of 12.6 mm diameter made of monel. The shell diameter is 356 mm. All the eight steam generators together supply 1,292 tonnes/hr of saturated steam at 40 atmosphere pressure with a maximum moisture content of 0.25 per cent.

Considerable amount of trial, training and testing was involved in developing the requisite manufacturing technology and expertise. A special clean room was constructed to ensure the quality of the tube assembly, especially the tube-to-tube sheet welding. Tube-sheet cladding with nickel and monel, optical alignment of the baffle bundle to ensure proper tube insertion, tube bend support system and tube-to-tube sheet welding were the main areas where development of technology called for a number of mock-up trials, training and qualification of personnel. The radiographic and ultrasonic examination of welds to special quality requirements and helium leak tests by vacuum also called for trials and training to establish the required accuracy of examination.

In addition to the above, BHEL, Tiruchi, also manufactured standby coolers and bleed condensers for MAPP, which form part of the primary coolant system circuit.

Fast breeder test reactor

For the FBTR project at Kalpakkam, BHEL, Tiruchi, was entrusted with the manufacture of intermediate heat exchangers, steam generators, sodium inlet/outlet pipes, straight pipes and special bends, reactor vessel shells and Y-bends.

The intermediate heat exchangers (IHX) (there are two of them in FBTR) form the link between primary and secondary liquid sodium. The total assembly

consists of 888 stainless steel tubes of 14 mm outer dia. The steam generators produce steam by extracting the heat from the secondary sodium supplied by the intermediate heat exchangers. The steam generator is constructed in the form of hairpin bends with hexagonally placed Cr-Mo steel tubes of 33.7 mm outer diameter kept inside a pipe. The secondary sodium circulates around the tubes with the demineralised water passing through the tubes. Four steam generators together produce superheated steam at 125 bar pressure and 480°C for a rating of 50 MW thermal. The material used for shell and tubing is 2-1/4 Cr 1 Mo alloy steel stabilised by niobium.

The block pile pipings mainly consist of sodium inlet and outlet pipes with provisions for overflow pipe, sodium emergency pipe, siphon break pipe etc. These are made by stainless steel material which connect the block pile and the intermediate heat exchangers.

A high degree of skill was required for manufacturing the stainless steel components to meet the stringent quality requirements and also the stringent dimensional tolerances. BHEL, Tiruchi, carried out necessary pre-production trials, mock-ups, procedure and artisan qualifications and successfully established their capability for manufacturing stainless steel components and assembly to meet the requirements. Hydro-testing with strain gauge measurements and helium leak testing by vacuum method were successfully developed. A dust free clean room for assembly operations and special facilities for acid cleaning, hydro-testing with warm water and helium leak testing by vacuum were specially installed for FBTR component manufacture.

The Department of Atomic Energy placed an order for the engineering and manufacture of the main heavy water heat exchangers for the Dhruva Thermal Reactor (R-5) project. The heat exchangers (there are three of them) are used to transport heat from the reactor coolant (heavy water) to the process water. Each heat exchanger is rated for 34 MW thermal. Each heat exchanger has 8245 stainless steel tubes of 9.5 mm diameter. All the tubes are 'tube-to-tube' welded and expanded. It required considerable expertise and training to ensure proper expansion of these tubes where the tube inside diameter of 6.5 mm limited the design of expansion tools. All the joints including the double gasketed flanges were subjected to stringent helium leak tests. This called for very high accuracy in machining the gasket faces of tube sheet and channel flange.

Narora project

For the Narora Atomic Power Project, BHEL has been entrusted with the design and manufacture of steam generators and reactor headers. The design of these steam generators is very different from those used in earlier units. The work on manufacture is progressing and the first steam generator will be ready for despatch shortly. Each of the two 235 MWe units at NAPP has four steam generators. Each steam generator has an integral heat exchanger and drum, with an annular downcomer. In all respects, this design is on par with the present day design in developed countries. The selection of

materials and design of components have been carefully done in order to increase the life of equipment. The pressure boundary is made of quenched and tempered steel of nuclear quality and tubes are made of incoloy. The tubes are supported by egg-crate type grids made of stabilised stainless steel. Each steam generator has 1830 'U' tubes of dia 16 mm. The heat exchanger portion of the shell is of dia 1960 mm and the drum portion is of dia 2600 mm and it has an overall length of 19.5 metres. The new design has called for the use of a different class of manufacturing technology altogether.

BHEL, geared up to this requirement by adding new facilities, extensive mock up trials and training. The fabrication of quenched and tempered steel, stainless steel, low alloy ferritic steel and inconel involved procedure and artisan qualification followed by testing to ensure that the stringent specifications are met. A numerically controlled deep hole drilling machine was procured and extensive trials with gun drills were made to establish the tube hole drilling to the required close tolerance on hole diameter, drift and pitch.

New welding procedures developed and successfully used include strip cladding (with inconel and stainless steel) and tube-to-tube sheet welding using pulsed TIG welding. The manufacture of lattice type grids involved machining to strict tolerance, assembly of grid flats on special fixture using resin bonded spacers and machining the assembly in that condition. All the internals like baffles and grids are assembled inside the steam generator, precisely controlling the alignment using optical methods in order to avoid tube insertion problems.

Local induction heat treatment had to be conducted at certain stages in the manufacturing process. The tube-to-tube sheet welding and tube expansion were independently qualified with helium leak testing by vacuum method. Helium leak test by vacuum for the complete steam generator assembly as well as hydraulic testing with hot demineralised water were some of the other areas of technology development. A large air-conditioned clean room of 2,700 sq. m. area has been constructed to ensure quality and cleanliness during assembly.

Manufacturing activities have already started on the steam generators for Kakrapara (2 x 235 MWe) project. Work has also been initiated for two more projects of 2 x 235 MWe capacity.

With the vast experience gained and the success achieved in the commissioning of nuclear power and research projects, the country is slated for achieving a tremendous growth in the years to come. The long term programme of the Department of Atomic Energy will be dominated by the installation of the standard 235 MWe power plants in the near future and 500 MWe power plants thereafter. BHEL, Tiruchi, is gearing up to augment its capacity for meeting the equipment requirements of the nuclear power development programme. An investment proposal for Rs 17.5 crores is under consideration. Detailed engineering studies have been carried out for the steam generators of 500 MWe units.

BHEL, Tiruchi, is thus poised to make significant contribution to the nuclear power programme of the country in the years to come.

/13046
CSO: 5150/0053

DEFENSE INSTITUTE HEAD DISCUSSES NUCLEAR POLICY

Bombay THE TIMES OF INDIA in English 13 Dec 85 p 14

[Text] Noted nuclear analyst, Mr. K. Subrahmanyam, says India's decision on the nuclear weapon option should be based upon what others think of the utility of the doctrine of nuclear deterrence.

In a talk over All India Radio on Tuesday, he said while India did not subscribe to the doctrine, the country's security and national interest demanded that as long as others believed in the doctrine's effectiveness, India had no choice but to take a decision on that basis.

Mr. Subrahmanyam, director of New Delhi's Institute for Defence Studies and Analysis, said the country's nuclear options had to be viewed, in particular, against Pakistan's quest for nuclear weapons.

He also said that the objective of Pakistan's five-point proposal to India appeared to be to disarm India of the nuclear weapon option.

Speaking about Pakistan's quest for nuclear weapons, Mr. Subrahmanyam listed the various developments since January 1972, when Zulfikar Ali Bhutto put that country on the nuclear road, and said, "We have to conclude that Pakistan is pressing ahead with its nuclear weapons programme."

Clandestine purchases of nuclear weapons development-related equipment from the world over, the US waiver of the Symington amendment clause and speculations of a Pakistan-China collaboration for uranium enrichment capability, with no peaceful programme for its use, were given by him as the reasons for such a conclusion.

Commenting on Pakistan's five-point proposal, which India has rejected, Mr. Subrahmanyam said the rejection had been on firm grounds. Inspection was pointless, as Pakistan's programme was clandestine and India had not the capability for fool-proof verification.

Mr. Subrahmanyam referred to the proposed US second tranche of military-cum-security related economic aid to Pakistan and warned, "Pakistan is able, to get through the aid, to acquire many more aircraft delivery systems for its nuclear weapons and it may not need the US to guarantee its security."

He noted that for India, becoming a nuclear power would be economic, as it would just be translating civilian nuclear and space capability to the weapons programme.

Mr. Subrahmanyam also noted that the Indian sub-continent was surrounded by three major nuclear powers: China and the Soviet Union to the north and the United States in the Arabian Sea and the Indian Ocean. Israel and South Africa, two other littoral States of the Indian Ocean, were widely believed to be in possession of clandestine nuclear arsenals. France, too, which was modernising its submarine-borne missile force, could deploy the force in the Indian Ocean, he added.

Mr. Subrahmanyam said that in the new "Star Wars" technology, the southern oceans, especially the Indian Ocean, would play a significant role, as Soviet satellites in their Polar orbits came very low here.

/13046
CSO: 5150/0050

INDIA

FRENCH AEC ADVISER TELLS POLICY ON TECHNOLOGY TRANSFER

Bombay THE TIMES OF INDIA in English 16 Dec 85 p 9

[Text] France is willing to transfer nuclear power technology to any Asian nation, including Pakistan, if it was approached, Mr. Georges Vendryes, adviser to the French atomic energy commission, said today.

He told reporters that Pakistan had not approached his country so far for transfer of technology, though it had approached some other European countries with bids for its nuclear power programme.

The power director of the commission said France was convinced that nuclear power was the only way of generating the energy needed to match the growing needs of every country. It was for this reason that France supplied South Korea with two 900 MW units of pressurised water reactors (PWRs), he added.

Mr. Vendryes said France was ready for discussions with the Indian government for transfer of any technology if the latter wanted to have collaboration with his country.

Asked about China's nuclear power programme, he said his country had agreed to help set up two power units of 900 MW each at a site about 50 km. north of Hong Kong. At least two-thirds of the power generated would be consumed by Hong Kong, he added.

PTI adds: Mr. Vendryes said France was very keen to renew its nuclear co-operation with India. But at the moment, France itself was very keenly watching the performance of the 13 MW fast breeder test reactor (based on the French Rhapsodie reactor) as it was using a new fuel, plutonium-uranium carbide. "This is a fuel which no one has tried so far in the world and we would like to see how India fares," he said.

He said France was delighted at the successful commissioning of the FBTR in Kalpakkam and thought "it was a beautiful achievement", considering very few countries went in for fast breeders.

Talking about France's achievement in erecting the world's biggest fast breeder reactor, the 1200 MW super phoenix near Leon city, he said, first criticality had been achieved in September and the scientists were proceeding cautiously in generating only 30 per cent of its power.

/13046
CSO: 5150/0051

INDIA

'SIGNIFICANT' URANIUM DEPOSITS FOUND IN MEGHALAYA

New Delhi PATRIOT in English 16 Dec 85 p 1

[Text] Shillong, Dec 15 (UNI)--Scientists of the Atomic Minerals Division (AMD) has located "significant" uranium concentrations in parts of west Khasi Hills in Meghalaya.

The scientists located the deposits while carrying out the exploration in the sedimentary rocks near Gomaghat, official documents available here said.

The document said scientists had recorded significant radioactivity in a number of outcrops of the Mahadeo formation, the focal point of search for uranium, along the Balat-Mania-Ranikor-Gomaghat-Nonghallam tract in the sandstones forming part of the lower Mahadeo formation.

The scientists, in course of their exploration, have so far recorded two radioactive zones in Gomaghat, each measuring more than 80 metre, the documents said.

Systematic channel sampling of 12 outcrop faces in the area revealed between 0.01 and nearly 0.1 per cent of uranium concentrates of thickness ranging from half a metre to about 2.55 metre.

This apart, the scientists delineated uraniferous greyish sandstone as discontinuous bands over 627 km tracts between Manai in the east and Ranikor in the west. They also encountered a 0.6 to one metre thick radioactive zone and found uranium deposits of 0.01 to two per cent, the document added.

The document said in Gomaghat the uranium appeared to be localised in the matrix and dimensions of the radioactive outcrops were comparatively larger.

In view of the encouraging results obtained in the Gomaghat area, the scientists felt that the possibility of locating "valuable uranium" deposits in Mahadeo formations appeared bright.

Earlier, the AMD scientists had struck uranium deposits in Aneak and uranium and thorium around Nenkhera in the Garo Hills.

/13046
CSO: 5150/0052

PAPER INTERVIEWS CHIEF OF SANE NUCLEAR COMMITTEE

Bombay THE TELEGRAPH in English 22 Dec 85 p 6

[Text] Should India embark on a nuclear weapons programme in response to the Pakistani bomb? Strong opposition to the widespread demand for an Indian bomb has come from the Committee for a Sane Nuclear Policy (Cosnup), one of India's leading anti-nuclear lobbies. Recently, Cosnup presented a memorandum to Prime Minister Rajiv Gandhi, calling for a nuclear weapons free South Asia and greater cooperation with Pakistan. Signatories to the memorandum included the former UN General Assembly president, Mrs Vijayalakshmi Pandit, retired Supreme Court judge V. R. Krishna Iyer, Lt Gen. Jagjit Singh Aurora (retd), writer and Rajya Sabha member Khushwant Singh, social scientist Rajni Kothari, civil libertarian V.M. Tarkunde, and champion of bonded labour Swami Agnivesh.

Prof. Dhirendra Sharma, convenor of Cosnup, was the chairman of the Centre for Studies of Science Policy, Jawaharlal Nehru University, before his controversial 1983 transfer to the School of Languages at the same university. He has taught at Harvard, Berkeley and several other foreign universities. Prof. Sharma spoke to THE TELEGRAPH on India's nuclear policy and related issues. Excerpts:

Q: Would India be justified in going in for a nuclear weapons programme now that Pakistan seems to be on the verge of acquiring a bomb?

A: No nation in the world, neither India nor Pakistan, or any other country, is justified in going in for such a programme because more than 50,000 nuclear warheads have already been stockpiled by the world's nations. This amounts to almost 17,000 million tonnes of TNT. This means that we have more than 3.5 tonnes of TNT per man, woman and child on this earth. And we can destroy the world 12 times over. We do not need any more atomic weapons on this planet!

India and Pakistan are facing severe problems of development. People have no food, no medicine, no education, no shelter. Any political leader of either country who speaks of or aspires to acquiring nuclear weapons is acting against the long-range interests of the people of this hemisphere. What we must remember is that the nuclear programme is irreversible. Once you start, you have to go on and on. Now, the super powers have reached a

level where they can neither destroy nor use these weapons. So, they are pursuing the "Star Wars" prgramme. The question is, do we have the resources to waste on a weapon that is non-usable? Neither Pakistan nor India can ever use such weapons with impunity in this hemisphere. The radiation fallout will be so devastating that even if a single bomb is dropped on India, Pakistan too will be finished. Pakistan can never dare to even threaten India with a weapon of such devastating power.

You should also keep in mind that there are more Muslims in India than in Pakistan and that the Pakistanis have relatives here. Even Gen. Zia-ul Haq's relatives are here. So, it is not possible for any leader on either side to consider using the bomb.

Q: What about the generation of nuclear power for peaceful purposes?

A: The argument is, though nuclear weapons are bad, nuclear power can be used beneficially. In the early 1950s this is what the world wanted. Jawaharlal Nehru too was very enthusiastic about the idea and India's Atomic Energy Act (AEA) 1962, says that we will use nuclear energy purely for peaceful purposes, for the welfare of the people. But this is where the catch lies. We call it the "Siamese twins." 'Atoms for peace' and 'atoms for war' are Siamese twins which cannot be separated. Even Oppenheimer observed that any politician who says atomic energy is to be used only for peaceful purposes, is not telling the truth. This is because the process of generating power by atomic fission yields nuclear waste which is highly radio-active. It has no other use but to be re-processed and this results in weapons grade plutonium. So, when you go for a nuclear power programme, you acquire plutonium, (which can be) used for making weapons.

In response to the demands of World War II, the advanced countries went for the weapons programme directly. It was only later that they used atomic technology for power generation. But India and some other Third World countries want to go for a nuclear weapons programme via the power programme.

No Third World country has the capacity to produce nuclear power cheaply and safely. In the advanced countries, too, there has been a total breakdown of the atomic power programme. More than 150 power projects have been shelved. There are no new proposals coming up. Many states in the US have banned the setting up of nuclear plants. The US nuclear regulatory commission, has imposed such stringent restrictions that it is not economically viable to have atomic power.

Q: Prime Minister Rajiv Gandhi said recently that India will be going in for nuclear plants in a big way to meet the tremendous demand for power in the next century.

A: This is definitely very misleading. Any government which talks of peaceful work, may secretly be preparing for war. The government says that it wants to generate 10,000 MW (of power) by 2,000 AD. But this is not possible. We do not have the necessary infrastructure, or resources.

Q: They seem to be preparing for that.

A: They are preparing for weapons. And I mean that. The nuclear scientists need a cover. They are working overtime to produce missiles, rockets and to store up enough plutonium to prepare warheads. So that, by 1995, when we have stored up enough plutonium and achieved a delivery system, India can come out in a big way to call itself a super power. The credit for this will, of course, go to the Nehru family's patronage of nuclear science and technology.

Q: Where will the money come from?

A: In the name of the electricity programme. The government has already sanctioned more than Rs 15,000 crores for "peaceful atomic energy." I have worked out that for 10,000 MW of electricity, almost 2,000 tonnes of heavy water are required annually, and we would need about 50,000 trained personnel to run 44 atomic power stations in order to produce 10,000 MW at the present level of CANDU reactors of 230 MW capacity. We will need over 32,000 tonnes of heavy water to produce 10,000 MW. The cost of 1 kg heavy water is Rs 15,000.

It will be totally ruinous for us. What is shocking is that to this day there are no plans, no blueprints for such a project. They only seem to be planning for plutonium reprocessing, laser technology and so forth. Thus, in the name of a nuclear power programme, the nuclear establishment is planning for something other than electricity. For it is easier to make a few nuclear warheads than to produce atomic power safely.

The Rs 15,000 crores sanctioned for the programme will double to Rs 30,000 crores by 1995. This is only the construction cost. The operational cost will be another Rs 20,000 crores. So, I estimate that Rs 50,000 crores will be required to produce 10,000 MW. A single megawatt of power will cost Rs 5 crores. This does not include what is called hidden cost.

There is another very important factor that should be considered. A hydel power station or a coal power station can be continued to be used for a long time if periodically improved or repaired (in case of damage). But an atomic power station has a life span of 25 to 30 years and it takes 10 to 15 years to construct at a cost of Rs 400-800 crores. Once it stops operating it cannot be dismantled. It remains dangerous for thousands of years.

Q: How dangerous is it to the environment?

A: Even when it is not operative, the plant may leak, releasing radiation into the air outside and underground water. Instead of squandering all much money on nuclear energy, the government of India should try to develop the renewable sources of energy available, such as the sun, wind and water. Only Rs 100 crores would be enough to produce 10,000 MW of power by exploiting these sources. We still have over 90,000 MW hydel electricity potential, from the Himalayas to the sea, that is simply wasting away. Atomic energy, however, is exhaustible. We only have uranium sufficient to generate 15,000 MW at the most.

Q: How do you view the present nuclear policy?

A: It seems that up to June this year the government had been constantly building up pressure to go for the weapons programme. It was being said that Pakistan had already exploded a nuclear device in China or was about to do it. At that time, the government was advised by the pro-bomb lobby that they should take a secret decision on the matter. In fact, even the Prime Minister in an interview that appeared in LE MONDE on June 4, said the decision would be secret. Earlier too he had said the same thing to Indian journalists.

However, the COSNUP protested against this. I also wrote to newspapers and to the Prime Minister that any secret decision to make a bomb would violate the AEA of 1962.

Q: Did Mrs Gandhi take a secret decision about the 1974 Pokharan explosion?

A: Not quite. She was wise enough to call it a "peaceful, scientific experiment." She did not violate the Act. Now here we have the director of the Institute of Studies and Analyses, Dr K. Subrahmanyam, and the pro-bomb lobby favouring a secret decision on the bomb.

Q: Do you think that funds are being diverted from the power programme to the weapons programme right now?

A: That's a very ticklish issue. We have no way of knowing. What is promising is that the Prime Minister, under pressure, has changed his stand. He said that when the government decided about the bomb, whatever the decision, "the people will be informed."

Mr Gandhi has recently made two or three very important remarks. One, he said that the government did not feel the need to make a bomb. Two, he said that if ever it did so, the people of India would be informed. It is a hopeful sign that the Prime Minister has committed himself and the government to the stand that the bomb will not be made secretly. In Japan, Mr Rajiv Gandhi declared unequivocably that even if Pakistaa made the bomb India would not. And here we can congratulate the Prime Minister.

Q: But you really don't know what is going on.

A: Nobody knows, not even members of Parliament can get full information and there is no accountability. Crores of rupees will simply be utilised secretly. But the point is that the decision will be told to the people of India, though, admittedly, the programme still remains a secret. In India if one opposes the nuclear power programme, one is dismissed as a CIA agent.

Q: Do you think it is time that the AEA 1962, which ensures the nuclear establishment complete secrecy, was revoked?

A: Yes. The government should appoint a non-governmental interdisciplinary commission of enquiry with the powers to reassess nuclear fission technology, its cost, its environmental impact, and then reassess the nuclear programme in relation to the energy requirements of the country.

The commission should have the power to look into the performance of the atomic energy establishment and also examine the AEA in the light of new findings. I would say that the Act is outdated. A modern state cannot allow a handful or even one man--the chairman of the Atomic Energy Commission (AEC),--total power to do or undo whatever fits or suits his whims or design.

To this day, the AEC has not come under the purview of the legal provisions which govern other scientific establishments in the country. Thus, the Act should be scrapped. Actually, one of the main reasons that the programme is secret is that as soon as you decide to make a bomb, all international cooperation stops. In India's case this happened after the Pokharan explosion.

Q: Now France has resumed cooperation...

A: France is following an independent policy, an arrogant and jingoistic one. Ignoring the protests of the South Pacific islands, Australia and New Zealand, and in violation of international treaties and sensibilities, it has been exploding nuclear devices in that region just to prove that it is a powerful nation. This type of arrogance is primitive. Now India too is in the same game. For the sake of self-glorification the government wants to show that we too can make big bombs, big weapons. However, the Prime Minister does seem open-minded, and in this there is some hope.

Q: Who are the policymakers in India?

A: Those who benefit from the programme. The ruling family, certain powerful industrial houses that get the major contracts from the atomic programme, and a small group of scientists. There is a kind of alliance, a closed network of a few top industrialists.

Q: Such as?

A: If you want me to name them--the Tatas, Larsen and Toubro, and about 25 other top companies involved in the atomic power programme. Dr Homi Bhabha was the chairman of the AEC from its founding in 1962 till he died in 1966. He was J.R.D. Tata's nephew. Mr Tata has been a full-time member of the AEC since 1962, though during the Janata rule he was out of it. Here is a man who knows nothing about atomic energy but is a full-time member of the AEC. When I wanted to interview him during the course of my research, he wrote back saying that he had done nothing but support Homi Bhabha. Interestingly, 60 per cent of the contracts of the AEC normally go to the house of Tatas. So, the total decision making process rested with one man who founded the atomic energy programme and provided contractual benefits to his uncle's companies.

The third party which has benefitted directly is the ruling party. The AEA says that the AEC chairman is directly responsible only to the Prime Minister. And Nehru agreed to all of Bhabha's suggestions. So you had Nehru, Bhabha and Tata working together. Those who get AEC contracts in secret have to give no accounts.

But there are overt linkages. The Nehru Centre in Bombay, for instance, gets funds from the contractors of the AEC. Dr Raja Ramanna is the general secretary of the Centre. Dr Sethna, former chairman of the AEC, is directly involved in running the Centre. I am not saying that the Centre is not doing useful work. But look at the linkages.

Q: What do you think of India's policy vis-a-vis the Pakistani nuclear programme?

A: In the past India's policy was ambivalent. We did not want to say clearly what we intended to do. Intentionally, the government was maintaining a confused policy. They were not confused among themselves, but they wanted to create the confusion. It suited the rulers who want to stay in power but have not achieved much on the home front. It suited our scientists who have not done anything really creative. However, Rajiv Gandhi has recently cleared the confusion.

Q: Can there be anything like a sane nuclear policy?

A: Some people believe that there can be no sane nuclear policy. But science is always a growing process. There are innovations, new discoveries and technological problems can be solved by new applications. And since atomic fission technology is still new, there is hope that in time some solution will be found to the problems it poses, of disposal of waste and environmental damage, etc. Nuclear physics was there even before some countries decided to go for atomic weapons.

We could apply atomic technology in medical research. As much as 50 years ago this was being done. But let the problems be solved before we decide to go for the atomic power programme in a big way. I think India should follow the example of those countries which are called threshold nations--Canada, Australia, Sweden, Germany, Japan. All these countries are technologically capable of going in for nuclear weapons. But they are not doing so. And they all have a very high standard of living. If we can eradicate poverty, see to the problem of education, ensure that our hospitals are well-manned, and so forth, then we will have delivered the goods. This would be a more scientific approach than storing up nuclear weapons which can be neither used nor dismantled.

/13046
CSO: 5150/0054

'CONGRESSIONAL SOURCE' CITED ON PAKISTAN BOMB CLAIM

Bombay THE TIMES OF INDIA in English 23 Dec 85 p 1

[Text] WASHINGTON, Dec. 22. The CIA has said that China may have tested a nuclear bomb for Pakistan, according to a reliable Congressional source.

At secret meetings specially held for the house foreign affairs committee, the CIA admitted that seismic shocks produced in China's Lop Nor desert area in May 1983 were from a nuclear explosion, the source said. However, it said it had no means of knowing whether China tested the nuclear device on behalf of Pakistan or performed one of its own experiments.

The CIA's admission gives the lie to earlier statements by American and Scandinavian experts that the seismic shocks had come from an earthquake.

According to the intelligence agency, the nuclear explosions could have taken place either on May 13 or on May 15. These dates are important, as they could establish the complicity of Pakistan. It had been reported, presumably first by Soviet intelligence sources, that on May 15, 1983, Pakistan's foreign minister, Mr. Yaqub Khan, was present at the test site to watch the explosion. This reinforced the speculation that the Chinese were testing the bomb for Pakistan.

The Pakistan government tried to allay these doubts by stating that Mr. Khan was in Beijing, China's capital, on May 15 and not in the Chinese desert. However, nuclear test experts here counter this argument by stating that the actual test might have taken place on May 13 and the seismic reaction on May 15 could have been the aftershock. And on May 13, Mr. Khan and a number of Pakistan's nuclear experts might have been at the test site.

U.S. INQUIRY

In a determined search for the truth, a group of Congressmen pushed the matter further by asking the United States air force to provide all its secret surveillance data on the May 1983 test. The air force monitoring system in this field is considered the most reliable, but it pleaded that in the case of the Chinese test it had not received the human intelligence data from the CIA. Normally, the technical data collected by the air force and the human intelligence information gathered by the CIA are collated to reach a final and reliable conclusion.

The question that arises is: Can Pakistan be satisfied with a nuclear weapon that it has not tried itself? One answer is that the atom bomb dropped on Hiroshima had not been tested at all. Besides, every atomic weapon in a country's armoury is not tested. Only the design is tested and every bomb is made in accordance with it.

Through the Chinese test in 1983, Pakistan may have acquired nuclear weapons capability without losing American military aid. The assistance might have been cut off if it had conducted the test on its own soil.

/13046
CSO: 5150/0055

INDIA

CPI WARNS GOVERNMENT AGAINST NUCLEAR BOMB

Calcutta THE TELEGRAPH in English 25 Dec 85 p 5

[Excerpt] New Delhi, Dec. 24: The CPI today urged the government not to get drawn into a nuclear arms race in the subcontinent but instead to concentrate on improving Indo-Pak relations in the direction of peace, friendship and cooperation.

In a lengthy political resolution at the end of its three-day national council meeting on the economic and political situation and foreign policy of the country, the party spoke strongly against the prospects of India going nuclear. It is the first political party to come out unequivocally against the possibility. However, the CPI general secretary, Mr Rajeswara Rao, refused to answer queries about the party's position on India's nuclear options if Pakistan acquired a bomb.

The resolution under the heading "International Situation," expressed concern at the US-backed efforts of Pakistan to get a nuclear weapon. It said: "instead of getting dragged into a nuclear arms race with Pakistan, India should stand firmly by its policy of opposing all nuclear arms proliferation, both horizontally and vertically. Any attempt by India to produce nuclear weapons will not act as a deterrent to Pakistan or bring additional security to India."

On the other hand, a nuclear India "will only aggravate tension and create apprehensions in the minds of neighbouring countries. Such a development will enable the imperialists to realise their ugly designs in the region," it said.

/13047
CSO: 5150/0058

INDIA

EDITORIAL WARNS SDI COULD LEAD TO NUCLEAR WAR

Bombay THE TIMES OF INDIA in English 27 Dec 85 p 8

[Editorial: "Fallacies of SDI"]

[Text] The Office of Technology Assessment, which is closely connected to the U.S. Congress, has come out with a report on the dangers of the SDI programme which has won the grudging admiration of SDI's supporters. They have praised the report for raising "the level of national debate." But the issue is no mere debating matter. Once the SDI is launched, the nuclear arms race will have acquired a different qualitative dimension. Everything must be done to persuade the American government to give up this programme the purpose of which, as the report points out, is not to protect people but to protect missile silos. Thus, even if the SDI were 99 per cent effective (which is quite impossible) the Soviets can, by targeting most of their missile force on cities guarantee (because of the one per cent "leakage") the destruction of America's 90 largest cities. Defence of the U.S. population, then, does not in the words of the report, "appear to be a goal of the SDI programme."

And what are its likely consequences? One effect would be to make nuclear war more thinkable. If both the U.S. and the USSR have similar limited defences, then there is an incentive for either side to strike first because the "ragged response" of the other would not be so damaging. In fact, the report clearly points out that the defence systems themselves are vulnerable to a pre-emptive attack, giving an "advantage" to the side that strikes first. The overall effect, therefore, is to tighten the Soviet and U.S. fingers on the nuclear trigger. Then "the technological uncertainties of missile defence may lead to strategic uncertainty--with defence there will be more possible outcomes but fewer certain ones, of a nuclear war." The supporters of the SDI are well aware of these criticisms and are trying to convince the American public and Congress that they can establish a "workable defence" and that deterrence will be enhanced at every level. But to make such a case, SDI experts have to take into account "rational Soviet military policy", i.e. anticipate and prepare for "rational" responses by the enemy. Clearly all this has little to do with strategic defence against anything the enemy may plan; it has much more to do with nuclear war fighting. The SDI is exposed for what it really is, not an instrument of passive defense but of dangerous offence. If a large part of the American public has, nevertheless, bought Mr. Reagan's rhetoric about space defence and the "peace shield",

this is partly because the insecurities bred by the escalating nuclear arms race have made them psychologically receptive to any programme that smacks of defence and safety against the unthinkable character of the nuclear threat that seems to loom overhead.

/13046
CSO: 5150/0057

INDIA

BRIEFS

FAST BREEDER REACTOR--New Delhi, December 11 (PTI and UNI)--India is engaged in designing and constructing a prototype fast breeder reactor which will be completed by the year 2000, the Lok Sabha was informed today. The minister of state for science and technology, Mr. Shivaraj Patil, told Mr. B. V. Desai and Mr. M. V. Chandrasekhara Murthy in a written reply the 500 MWE reactor matched coal-fired thermal power stations. [Excerpt] [Bombay THE TIMES OF INDIA in English 12 Dec 85 p 12] /13046

URANIUM MINING PLANS--Jamshedpur, Dec. 23: Uranium Corporation of India Limited (UCIL), Jaduguda, is planning to increase its production capacity by opening two more mines and resuming work in Bhatin mine that has been kept closed for quite some time. The new mines at Naroapara and Ruramdih are in Singbhum district. According to a UCIL spokesman, the expansion programme will entail a capital outlay of Rs 186 crores inclusive of a 3000-tonnes capacity new ore-dressing plant. The UCIL is taking measures to effectively contain radioactivity in its mines to prevent the people living in the vicinity of the plant from getting exposed to radioactivity. [Text] [Calcutta THE TELEGRAPH in English 24 Dec 85 p 10] /13046

CSO: 5150/0056

PAKISTAN TO JOIN EUROPEAN NUCLEAR RESEARCH CENTER

Karachi DAWN in English 7 Jan 86 p 8

[Text] Dr. Abdus Salam, Nobel-laureate, said here on Monday that Pakistan has decided to apply for the membership of the prestigious Centre for European Nuclear Research (CERN).

Quoting Dr. Mahbubul Haq, Federal Finance and Planning Minister, as saying that the Ministry of Science and Technology had been asked to take steps to join the CERN, he said the membership of the organisation, which verified his theory of particles, which won him the Nobel prize in Physics in 1979, will have a great symbolic value. Fourteen European countries are members of this body and recently, Turkey, Jordan and Egypt applied for its membership.

The CERN, with its headquarters in Geneva, has an annual budget of a quarter billion dollars with a laboratory worth half a billion dollars set up in 1958 and the biggest anywhere in the world.

Dr. Salam, who is a member of the Science Policy of CERN, said that Turkey, Jordan and Egypt have applied for the membership on his urging that technology cannot survive without high-level scientific base.

This organisation, he said, conducted a course in Sri Lanka last year and carried its equipment all through and this year another course is being conducted in Beijing. The Organisation also supplied one million dollars worth of equipment to the International Centre for Theoretical Physics at Trieste which Dr. Salam is heading.

The Third World Academy of Sciences of which he is president, has offered 10,000 dollar scholarship for research work to scientists within their countries.

The amount of scholarship will be $10,000 a year for a period of four years.

He said not a single application has so far been received from any Pakistani scientist.

The Academy, he said, will also announce annual prize for distinguished scientists for their work.

Dr. Salam said that the Third World Academy of Sciences was provided a $1.5m by the Italian Government, $0.5m by Canada, and Kuwait has agreed to pay for the cost of all publications.

The Academy has four members from Pakistan including himself. The other three are: Dr Salimuzzaman Siddiqui, Dr Akhtar of South Ampton University, and Dr Ataur Rahman of Karachi University.

Dr. Salam laid emphasis on basic sciences and said it is lacking to some extent in UK also and leading scientists including himself have contributed funds for a full-page ad in London Times to be published on Jan 11 appealing to the governments to provide fair percentage of their GNP.

Dr. Abdus Salam said, universities in Pakistan are "dead" and the amount of funds is not increasing for science and technology.

Prof Salam, who arrived in Karachi on Sunday on a two-day visit on his way to a number of South and Far Eastern countries on a lecture tour, said, the scheme will be run by two Pakistanis, Dr. M. Shafi and Baqi Beg, who are based abroad.

He was happy to know that during his current visit NIAM-78, a new cotton variety, has provided the country additional income of 30 million dollars in the Punjab in one year alone.

NIAB-78 variety was produced at the PAEC's Nuclear Institute of Agriculture and Biology.

71/878
CMD: 3100/4732

PAKISTAN

PANEL SUPPORTS PAKISTAN BECOMING ATOMIC POWER

Lahore NAWA-I-WAQT in Urdu 15 Nov 85 Magazine pp 2-3, 20

[Panel discussion organized by NAWA-I-WAQT, moderated by Irshad Ahmad Arif]

[Text] Members of the panel are:

Air Marshall (Ret) Zafar Chaudhary, former head of the Pakistan Air Force

Mohammad Hanif Ramay, leader of Pakistan Musawat Party

S.M. Zafar, secretary of Pakistan Muslim League

Dr Parvez Hasan

Maj Gen Mumtaz Ali (Ret)

Sayed Fazal Hyder

Professor Hasan Askari

The moderator was Mr Irshad Ahmad Arif.

Moderator: I welcome you all to a discussion. Our topic for today is Pakistan's nuclear program. There is a general outcry in the world that Pakistan is building a nuclear bomb and sabotaging the peace efforts in the region. We shall limit our discussion to two points: 1) Have we the capacity to build a nuclear bomb and, 2) Can we afford it? Suppose we acquire the capacity to build such a bomb, how are we to cope with the other issues that are sure to accompany it? Above all, is it essential to become a nuclear atomic power to live in peace and security? First of all, I invite Air Marshall Zafar Chaudhary to give us his views on the matter.

Zafar Chaudhary: First of all, I must make it clear that I do not know whether Pakistan is engaged in building nuclear weapons or not. All I know is that the world news media accuse us of being engaged in building a nuclear bomb, while our President says most emphatically that we have neither the capacity nor the desire to build nuclear weapons, our nuclear program being

limited to the generation of power for peaceful purposes. India has declared that it has no nuclear bomb, but if Pakistan builds one it will build one also. Now the question arises: Why should Pakistan want to build nuclear weapons? It is true that Pakistani scientists have the ability to build a nuclear bomb, and may have to do so as a deterrent against India who has, as some believe, already built one. Now the question arises: Will Pakistan's nuclear weapons serve as deterrents against India? It is a fact that India is stronger than Pakistan militarily, industrially and economically. Its army is much larger than that of Pakistan. It can harm Pakistan and can even grab some of our territory. Even if India has nuclear weapons, it will never have to use them. Suppose India were to attack a part of our country. It is strong enough to defeat us without the help of nuclear weapons. Suppose we were to use a nuclear bomb in self-defense. India would use atomic weapons in greater numbers, and consequently Pakistan would suffer more. We know, and so does India, that nuclear warfare will harm us more. When we are attacked with conventional weapons, we have to answer with conventional weapons. Under these circumstances, how can a nuclear bomb be a deterrent? Again, our priorities are political stability and economic progress. We should spend money on giving our people the basic needs of life, i.e., food, shelter and education. We should not spend money on nuclear weapons. That will lead only to our own destruction.

If we build an atomic bomb in secret, how long can we keep it secret? When the secret it out, we shall lose our credibility, since our president has declared that we have no intention of building a nuclear bomb. Nobody after that will believe us and no country will help us. We buy arms from developed countries. When they find us untrustworthy they will stop selling us weapons and we shall be left quite defenseless. Many countries in the world (e.g., Japan, Canada and Germany) have the capacity to build nuclear weapons, but do not do so. They think such weapons are useless for self-defense. Some of them have made pacts with particular superpowers to give them guarantees that they would be saved in the case of a nuclear attack by an adversary. We may call this a diplomatic defense against a nuclear attack. They try not to get involved in any regional quarrels. We, too, can probably get such a warranty from a superpower. The best method, of course, is to be on good terms with our neighbors and eliminate the chances of war. War never solves, but only increases problems.

There are many other countries in the world that have strong neighbors. Do they defend themselves with the help of nuclear bombs? They do so with the help of good-will missions. We, too, should do that and try to eliminate the basic causes of our quarrels with our neighbor.

S.M. Zafar: It is a fact that Pakistan is trying to harness nuclear power, but nobody believes that we shall use this power only for peaceful purposes, that we shall never make atomic weapons. Other nations are suspicious of us and they have a reason for their suspicions. Gaining nuclear capacity is a long and arduous task, but once the technique has been mastered it is comparatively easy to build a nuclear bomb. In a few words, we can say that this capacity means the know-how to separate the lighter, finer and purer

kinds of uranium from its heavier kinds. Once this pure uranium has been attained, it is used in a reprocessing plant to make electricity. This same uranium, (after a little more research and study) when used in a certain proportion and joined with a switch to split the atoms, results in a nuclear bomb. A country is said to have a nuclear bomb when it has conducted a nuclear explosion. No country can produce a nuclear explosion without first mastering nuclear technology.

A country is said to have become a nuclear power when it conducts a nuclear explosion. If a country learns the know-how to purify uranium before making an explosion, it generally keeps the fact a secret. This fact comes to light only when a country either conducts an explosion or allows international teams to inspect its installations. At this moment Pakistan has the following options:

1) It should tell the international agencies all that it has achieved so far and stop any more work on nuclear technology. In that event, even France will give Pakistan the reprocessing plant it has recently refused to give.

2) Pakistan should continue to work in silence, until it has mastered the technique of refining uranium, and stop short of building a nuclear bomb. (This is, probably, the policy our government is following at the moment.)

3) It should conduct an explosion, if possible.

I find the first option quite unthinkable. The next decade is going to be the decade of nuclear technology. The countries that want to resolve their energy crisis will have to adopt nuclear technology.

Ayub Khan's cabinet started the task of setting up an Atomic Energy Commission in Pakistan in 1965, with I.H. Usmani as its chief. This work progressed in the days of Mr Zulfiqar Ali Bhutto. America tried to stop the work by sending Mr Henry Kissinger to Pakistan. The present government, too, is being pressured in the same way. It is good to know that all the changing governments have had the same attitude toward the atomic energy program. Not only that, but even the new generation of Pakistani scientists, who were having an easy life in developed countries, have come back to work in their own homeland. As a result of these people's hard work, now Pakistan's name is at the top of the list of the countries that are on the verge of becoming nuclear powers. We should not stop our nuclear program at this juncture, for it will mean the waste of all that time, money and energy that have already been spent on it. Another consideration that has become useless now is that other nations will not believe us when we say that we do not want to build a nuclear bomb. Nobody believes us now and nobody ever will. Why? Because there is so little distance between the capacity for producing nuclear energy and building a nuclear bomb that no country that does one can refrain from doing the other.

Again it has been a tradition of the "nuclear club" to try to keep down the number of its members. They go on opposing a country aspiring to become nuclear until it becomes a member. Then they accept it. India is opposing

us partly because it has become a member of the nuclear club and does not want us to do so and partly because opposing Pakistan in everything has become India's historical role. All nuclear powers are trying to place hurdles in our way. Israel may try to harm our power plants. The question is: Is it enough to tell Israel that if it tries to harm our power plants we would fight back? This threat has served its purpose but is now outworn. I think Pakistan should adopt the third option now. We have learned to purify uranium. Now we should, with the help of God, produce an explosion. It will stop all danger of war in this region just as the nuclear strength of the two superpowers has eliminated the danger of war between them since World War II.

General Mumtaz Ali: Let us consider our position at this moment. We are at a crossroads. We shall have to play our cards with great care. Why is India building up such military strength? Where is the danger it wants to counter. It has the Himalayas in the north, the sea in the south, on the east and west it has small countries like Pakistan and Bangladesh. For what purpose is India making such big military preparations? I think curbing nuclear proliferation is essential for peace. I agree with Zafar Chaundhary there, but I think a nuclear bomb will be a good deterrent. Hence I think, since India has become a nuclear power, Pakistan should become one also. Just as the United States and the USSR do not dare to attack each other, because both are nuclear powers, so Pakistan and India will stop threatening each other when they both become nuclear powers. Our nuclear strength should be at least one tenth of India's. We shall never use our nuclear weapons against India nor they against us. Like the two superpowers, we shall keep atomic weapons to prevent war.

I know we have the know-how to make nuclear weapons. We have very able scientists. Now we come to the second question: Can we afford an atomic bomb? This is in fact two questions: 1) How much will we have to pay for it? 2) What will the delivery system be? If India is willing to make a no-war pact with us, well and good. If not, we should build nuclear weapons and use them as a deterrent against an attack from India.

Saved Fazal Hyder: Our army has always kept its activities secret from the people, not only during the last 8 years, but even before that. We have never known the whys or wherefores of anything. We have had to learn all about our future, defense and form of government from the foreign media. I think, in the modern age, nuclear proliferation is not the problem. The question is how any power is going to use its nuclear capability.

As long as the United States had not exploded the atomic bomb it was an invincible power, but owing to the spread of nuclear technology the United States and the USSR can annihilate each other within a few hours. For the question of whether Pakistan should build the bomb or not, let me recount what happened last year. A team had come here from India. I talked to them about the defense conference they had at Delhi which was attended by civilians as well as by the military (unlike Pakistan where civilians are kept away from all discussion of defense). When I was in America, I watched a film about the progress different countries are making. It showed all the work being done at Kahuta. It was said in that film that since Pakistan is on the verge

of becoming a nuclear power. Pakistanis should have the honesty to own up to it; they should stop denying it. But I was telling you about the conference that I attended in India. Somebody asked there if the next war between India and Pakistan would be another 17-day luxury or something more serious. Someone replied that the next war between India and Pakistan would come to its logical conclusion. I asked them to explain the logical conclusion for Pakistan. I asked them if they wanted to destroy our army, annihilate our population or weaken our country by partition. They did not answer any of my questions. I think the basic cause of the bad blood between the two countries is that Liaqat Ali with his challenging "fist" and Nehru with his challenging tongue thought only of their own political power. They did not try to base the mutual relations of the two countries on good-will and peace.

However, before making a nuclear bomb we should ask ourselves: Have we become self-supporting in conventional weapons? If we cannot even manufacture our own guns, we should use our nuclear capability for social and economic priorities. We should be on good terms with our neighbors and save the defense money. The army should be kept busy on projects for social and economic progress.

Professor Hasan Askari: I think we should continue our present nuclear policy to develop our nuclear capability without building a nuclear bomb and without giving up the option. If we ever build a bomb, it will be with India's consent. Being the first to make the bomb will not benefit us at this juncture, since it will not increase our capacity for self-defense. It will only increase our defense budget abnormally without solving our problem of self-defense. Building a nuclear weapon is not a simple matter. It triggers a series of other problems that must be solved as we go. First of all, we must find the means to build nuclear weapons. Once the means have been found our position will become stronger, but we should not take the first step. We should let India do that. Taking the first step will spoil our diplomatic position. If we promise at the United Nations that we are not building the bomb, and then produce a nuclear explosion, where will our credibility be? We need this credibility since we depend on U.S. aid. For some weeks past, India has been raising a hue and cry about Pakistan's building a nuclear bomb. I think only regional politics is at the root of this noise. Our pact with the United States is at an end and a new one has to be made.

India wants to spoil our chances of concluding a new useful pact with the United States. They want to tell the U.S. Senate that it is making a pact with a country that is building a nuclear bomb. When the pact has been concluded, the hue and cry will stop. If some day in the future India attacks our bases, it will say that it is attacking Pakistan over the nuclear program against which it had warned the world in the past. There is another reason for the anti-Pakistan propaganda on the part of India. In December, a conference of the regional powers of Southeast Asia is taking place in Dhaka. The problem is that the smaller countries of the region are afraid of India in the economic field. India is fearful of the smaller countries joining together to form a front against it. India is giving Pakistan a bad name because it does not want it to become a leader of the smaller nations of the region and attack India. To prevent this, India is saying that Pakistan is developing nuclear weapons and blocking the way of peace. Under these circumstances, we

should try to strengthen the cause of mutual protection and try to make South-east Asia a nuclear-free region. We cannot prove India's propaganda false by building a nuclear bomb.

Mohammad Hanif Ramay: Islam means peace and security. A true Muslim wants peace not war. But our idea of peace is not to turn the other cheek after receiving a slap. Our Koran teaches us just the opposite lesson. In verse 60 of the Surah Infal, God says: "Be prepared for war so that the stamping hoofs of the stallions protecting your borders may strike terror in the hearts of God's and your enemies." It means that we should be so well prepared that our enemies should not dare to attack us. War is all around us. Our long eastern border with India has always been insecure, but now war has come to our northern border, too. We were one-fifth of India in 1971. Now we are only one-tenth. India's expansionism will make it attack us sooner or later. The only way we can protect ourselves is by developing nuclear weapons.

Do you think India will spare us if we do not develop nuclear weapons? It is not so. India will refrain from attacking us only if we possess nuclear arms. The atom bomb used in 1945 was the first and last such bomb ever used in history. Ever since other countries learned nuclear technology, no more atomic bombs have been used. The spread of nuclear technology has proved a deterrent to nuclear war. In our region, India, China and the USSR all have nuclear bombs. The sky will not fall if Pakistan also gets nuclear weapons. Why should Pakistan be singled out to be kept unprotected? It is ironical that even the United States, for which we have pawned our independence, despite being free, is against our protecting ourselves. Not only that, but it has even told India to deal with our country directly. Why? Because our rulers, who obey the United States at every step, have shown the courage to refuse to give U.S. bases like Budpir, and denied it the right to fly helicopters and planes across Pakistan to drop weapons to help the Afghan mujahidin. If the Gorbachev-Reagan summit next month is unsuccessful and the Soviet troops do not leave Afghanistan, U.S. pressure on Pakistan will increase. If our rulers do not obey the United States, it will retaliate by letting India attack us on the pretext that we are building a nuclear bomb. The United States knows that as soon as this happens the honeymoon of India and the Soviets will come to an end. They will become rivals just as India and China forget their friendship after the war of 1962. The United States is going out of its way to flatter Rajiv Gandhi because it wants to cause a rift between India and the Soviets.

The security of Pakistan is our own responsibility. If we do not build the nuclear bomb at this juncture, it will be treachery of our homeland.

Dr Parvez Hasan: I have always said that our mental attitude towards India is quite wrong.

The rising generation in the two countries does not agree with ours. It will not be long before the people of both these countries will live in peace together. If the United States, which dropped the atom bomb on Japan, can become a friend of Japan, and the Germans and French can become friends, why can we and India not forget our quarrels? Let me put it another way: Our birth-rate is very high. Soon our population will reach a level where everybody will

become poor. There are only a few ways to cope with this state of affairs. Our economy has long been dependent upon the foreign exchange sent home by Pakistanis working abroad, but that is not a dependable source of income. What is the way out of this situation? One way would be to discover oil in the country. There are examples of countries that solved all their economic problems after they discovered oil. The second method is this: Pakistan has plenty of arable land and the best irrigation system in the world. If we mechanize our agriculture and do things in a scientific way, Pakistan can, perhaps, become the foremost food-producing country in the region. This will solve most of our problems. The noise about the Islamic Bomb is both good and bad for us. It is said that Pakistan is building a nuclear bomb, but the money is being provided by another country. This is good news. If we build the bomb without spending our own money, it will make us a member of the Nuclear Club. We will be criticized for a short time, but the world will accept us, as it always accepts those who succeed in producing a nuclear explosion. Nobody liked our idea of founding Pakistan, but when Pakistan had been created everybody accepted us. So we will be accepted as a nuclear power. If we conduct a nuclear explosion without spending our own money, it will add to our honor. Conducting a nuclear explosion will give us a prestigious place in the third world, especially in the world of Islam. If some countries in the world think we have the capacity to produce a nuclear explosion, why should we deny it? I think once we build up a reputation as a nuclear power, many trade missions will start coming to us from all over the world. In the past, foreigners used to say about us: "These people cannot even sink a tubewell." When foreign engineers came to construct our Tarbela Dam, they asked if we had men who could drive tractors? People in other countries think we can do nothing, and need other people to do everything for us. Why were there more tenders for the Tarbela Project? Because at Mangla, the foreigners had discovered that this country has very capable men. Despite being uneducated our men worked the machines with the dexterity of those who had handled machines for generations. What I am trying to say is that producing a nuclear explosion will add to our prestige and give us a place of honor among the nuclear powers. Nobody will ask, "Can Pakistanis sink a tubewell?" They will say instead: "Pakistanis can build a nuclear bomb." This will bring us self-confidence. We shall enter the world of business with greater courage and be more successful. We will make progress like China where technology is transferred freely and every country is helped to make progress. This was the economic side of the question. I believe that some day our differences with India will be resolved and we shall come to terms with each other. It may take 10 or 20 years, but it will come about. Until such a time, there is no harm in building a nuclear bomb or two. This is the defense side of the question. Now, sir, we shall discuss the peaceful use of nuclear energy. We need to use this energy for generating power, though no foreign power believes us. The report of the Energy Committee says that our energy needs cannot be met by our present means.

That is why I said the night the budget was passed, "Your methods will fail. Only a deficit budget will result."

Zafar Chaudhary: Mumtaz Sahib, you have said that if India builds a nuclear bomb we should make one as well. You also said that we should have a deterrent (This word has become a cliche by now). We must first determine if the enemy intends to use the bomb. Then we have to find out when he intends to do so. A deterrent is something that prevents someone from doing something. Let us be practical. Let us suppose India takes possession of a part of the Siaichin Glacier. Will our having a nuclear bomb deter it from doing so? Or, to come nearer home, suppose India occupies a part of our territory in Rajasthan. How will our having a nuclear bomb prevent it from doing so?

Maj Gen Mumtaz Ali: The bomb is always used in the last resort. Our border with India is very long. If they build a bomb, we should build one also, and I believe they have built one.

Zafar Chaudhary: But if India has 100 atomic bombs, will it bully us?

Maj Gen Mumtaz Ali: They deny having any bombs at all, and also refuse to let inspecting teams enter their country. What does that prove?

Zafar Chaudhary: If Russia and the United States use nuclear bombs against each other, their great distance might save them, but India and Pakistan have the same borders, neither of the two countries can drop a nuclear bomb on the other without harming itself. It is just like Germany dropping a nuclear bomb on France. Only a brainless general could give such an order.

Question: Suppose both India and Pakistan procure nuclear bombs, will it not rule out the possibility of a war between them?

Zafar Chaudhary: No, because war will be fought with conventional weapons. The nuclear bombs will harm both sides equally.

Hasan Askari: In my opinion it is not essential for us to have a nuclear bomb only because India has one. In such a case, we should study the situation and try to find ways and means of protecting our country. Our aim is security and not merely to build a nuclear bomb. We should try to save our country by diplomatic methods or through guarantee from an international agency.

Zafar Chaudhary: My point is that after proclaiming to the whole world that we are not building the bomb, if we build one, we shall lose our credibility. I am not discussing whether we need such a large army and so much ammunition or not. I want to say that 90 percent of our weapons are imported. After we lose our credibility, neither the Soviets nor the United States will give us arms. Nobody after that will trust us. I agree with you when you say that conventional weapons should be answered with conventional weapons. We should be able to meet the enemy's challenge at every level.

Mumtaz Ali: The fact is that we know nothing about the expenses of building a nuclear bomb. When we think of the nuclear bomb we have in mind the bombs that destroyed cities like Hiroshima and Nagasaki. Smaller nuclear weapons, too, are being made these days. The question is: First, have we the capacity to build them and, second, can we afford them? What will be the political

consequences of making an atomic bomb? I do not think that will make us lose our credibility. Look at Israel, South Africa and India. They have prestige, because they have power. Might is right in this world.

Question: We have been hearing a lot about Kahuta in the world media. A common Pakistani thinks that there must be something in it. Tell us this--have you only prepared to save Kahuta in the event of an air raid by India, or are you well prepared even if India makes a paratroop landing in our country?

Zafar Chaudhary: Personally I know nothing about the steps that have been taken for its protection. If the installations are underground, how deep are they? If a nuclear bomb is dropped on them, they will surely be destroyed. But I think they cannot be destroyed with the conventional weapons of war. If the installations at Kahuta have been constructed according to the latest technology, with the posisiblity of an air attack in view, then it would be difficult to destroy Kahuta.

As for paratroopers, I am sure arrangements have been made against them. In war, fortune favors those who are more alert and have made better preparations. We can never foretell in war.

Afzal Hyder: There is a danger of sabotage. You may call it commando action, but surely our air force must be protecting it.

Question: India is always making noise about the F-16. Is it true that the Jaguar cannot compete with it? Suppose two squadrons of Jaguars attack us, would it be possible to repulse them with the number of F-16's we have?

Zafar Chaudhary: Compared to the Jaguar, the F-16 is definitely superior, but having a few F-16's will not reverse the balance of power in our favor. India is 4-5 times stronger than we in military power. That fact remains even after we got the F-16. Then the last war between India and Pakistan will be fought on land, not on the sea or in the air.

Question: Have we got the means of delivery?

Zafar Chaudhary: No, we do not possess a rocket that could place a bomb in a particular location. It is possible for it to go to another place instead. It is even possible that the bomb will fall on one of our own cities. Aircraft is the only method of bombing a target. India, too, is in the same plight probably. As to the question of how many bombs a plane can carry and how far, it depends on the volume and shape of the bombs. I do not think a plane can carry four bombs to be dropped at different points.

Gen Mumtaz Ali: I want to say that a nuclear bomb, as such, is a big thing, but some countries have smaller nuclear bombs that can be used in the battlefield. There are small nuclear weapons that can be used against armies. It is hard to say which country has them.

Zafar Chaudhary: This advanced technology is beyond the means of both India and Pakistan. Then why should we make small nuclear weapons? Why not fight with conventional weapons instead? We should not try to compete with India. This is an impractical and impulsive way of thinking. Before 1971 there was some justification for this sort of thinking, but now it is out of date. India is 8 to 10 times stronger than we in most levels. If we think we can defeat India, it is unrealistic.

Question: We have been hearing for a long time that India is stronger than we. We have accepted it as true. Even our generals and intellectuals have accepted it. Have you ever thought about the negative effect of this belief?

Fazal Hyder: I say again that if you have it, you should have the moral courage to say that you have it. Do not play a double game.

Question: You said that the countries that do not need atomic weapons join a pact or depend on some particular country. They break the rules of non-alignment. Should we, too, join a military pact?

Zafar Chaudhary: I did not mean that. You see, we have tried both SEATO and CENTO. Our aims did not tally with those of the United States and France. That is why the pacts were unsuccessful. All small countries of the world are not members of such pacts. They have found their balance in their own particular position and environment. In every case we must be realistic, and make our plans and policies accordingly. This is not an impossible task.

Question: I thank you all. Good-bye.

12476/7358
CSO: 5100/4723

END

END OF FICHE DATE FILMED

27 FEB 86